The
Geographical Journal.

No. 3. MARCH, 1899. Vol. XIII.

THE PLAN OF THE EARTH AND ITS CAUSES.*

By J. W. GREGORY, D.Sc.

The Variations of Topographic Form.

Despite the extreme variability in the shapes of the continents and their apparently capricious distribution, geographers of all ages have believed that the arrangement of land and water on the globe is based on a regular plan. The plan can, of course, only be recognized in broad outline, for the shape of the land-masses depends on the structure of the Earth-forms, which vary indefinitely. Intricate mountain valley systems open out to wide-flung rolling prairie, stoneless alluvial flats are broken by the crags of rock ridges, volcanic cones stand isolated like pyramids while mountain chains run thousands of miles unbroken. Such contrasts are natural, as the land-forms are the result of the struggle of complex forces with varying powers of attack against complex rock-masses formed of materials having varying powers of resistance. Coast-lines, for example, project where hard rocks repel the surf, where rivers deposit alluvium more quickly than the tide can remove it, or where the winds build up sand-dunes, whose very weakness disarms the waves. Coast-lines are indented where soft beds crumble under frost and rain, and where dominant winds, the inset of an ocean current, or an undulation on the sea floor directs a jet-like stream of water against the shore. Topographical form depends on so many incalculable, inconstant factors that the stages of its growth are often now untraceable. The missing links of geographical evolution are indeed as numerous as those of organic evolution, and the chapter of accidents is invoked by geographers to explain difficulties analogous to those for which naturalists appealed

* Read at the Royal Geographical Society, January 23, 1899. Diagram, p. 336.

to the doctrine of special creation. But unexplained differences in the geographical units no more disprove an orderly progress in the growth of the continents than the existence of isolated, unexplained groups of animals is fatal to Darwinism. Such topographical differences are of secondary importance in contrast to the numerous coincidences and repetitions of the same essential form among the geographical units. Geographers accordingly have believed that there is a hidden continental symmetry which, when discovered, will explain the law that has determined the distribution of land and water on the globe.

This idea dates from the dawn of geographical science. The early classical geographers noticed how the seas radiated from the Levantine area, and opened to a broad boundless ocean. They accordingly described the land of the globe as an island, floating on a vast surrounding sea, whence channels converged towards the hub of the classical universe. This radial plan reappears in the mediæval wheel-maps, in which Jerusalem was accepted as the centre of the world, whence the main geographical lines radiated like the spokes of a wheel.

These systems fell for ever on the discovery of America, which could not be brought into conformity with the radial plan by even the ingenious devices of mediæval cartographers. Later on came an even worse blow. Geologists showed that, instead of the land areas being fixed and immutable, they are really more fickle and less enduring than the sea. The distribution of land is therefore constantly changing, owing to local variations in its level. The discovery of this truth seemed to destroy the very basis of any possible Earth-plan. Indeed, Lyellism, with its essential doctrine of the alternate elevation and subsidence of the land under the agency of local causes, seemed inconsistent with the existence of any general cause governing the geographical evolution of the globe as a whole.

But a truer appreciation of this later knowledge did not confirm these first deductions. America is now used as the typical or, to borrow a biological phrase, the schematic continent. And when, remembering the probability of local variations in land-level, allowance is made for them, new resemblances are revealed, and exceptions that once were serious difficulties are removed. For instance, the oceans all end in triangles pointing to the north. This is the case with the Pacific, the two sections of the Indian ocean, and the basins of the Mediterranean. The Atlantic alone is broadly open at its northern end. But Scotland and Iceland are connected by a submerged ridge, which is said to be capped by a line of old moraine. If this ridge were raised to sea-level, the Atlantic would conform to the general rule by tapering northward to a point between Iceland and Greenland.

Similarly with the land-masses. There seems at first sight no resemblance in shape between the Old World and the New. But the Old World is divided into halves by a band of lowland, which extends

southward from the Arctic ocean to the Caspian, and northward from the Arabian sea up the Persian gulf. There is evidence to show that the sea recently covered these northern lowlands and occupied the Persian depression; while somewhat earlier, in Miocene times, the intervening ridge was also submerged. Restore these conditions, and the continents would occur as three meridional belts, each broken across by transverse Mediterranean seas, viz. North and South America separated by the Caribbean depression; Europe and Africa (the Eurafrica of Prof. Lapworth) separated by the Mediterranean; Asia and Australasia divided by the Malaysian folds.

Hence the oscillating character of the land, which appeared fatal to the old faith in an Earth-plan, helps to justify it, now that oceanography and geology have shown us how much to allow for the obscuring action of these changes of level.

But it is inadvisable, in attempting to explain the existing plan of the Earth, to introduce any alterations in the distribution of land and water. For, although a geologist may have no doubt about such assumed changes, he cannot expect geographers to have an equal faith in them, or even to take much interest in a world thus modified. The geographer is concerned with the existing arrangement of the world, and not with the more or less problematical plans of former ages. The introduction of earlier and more primitive geographical systems, though it would simplify the question, is unnecessary, since the existence of a present Earth-plan is clearly revealed by three striking facts.

Geographical Symmetry.

Two of these facts are stated in every geographical text-book. They are evident on the most casual examination of a map. The first is the concentration of land in the northern, and of sea in the southern hemisphere. The second is the triangular shape of the geographical units. The continents are triangular, with the bases to the north. The oceans are triangular, with the bases to the south. Accordingly the land forms an almost complete ring round the north pole, and from this land-ring three continents project southwards. The oceans form a continuous ring round the south pole, and from it three oceans project northward into the angles between the continents. The belts of sea and land are fixed on the Earth's axis like a pair of cog-wheels with interlocking teeth. These two belts may be referred to as the northern land-belt and southern oceanic belt.

The third striking feature in the Earth's physiognomy is less conspicuous, but is even more significant. It is known as the antipodal arrangement of oceans and continents. It is most easily recognized by examination of a globe; but it can easily be illustrated by a plain map. The antipodes of a point in the centre of the continent of North America occurs in the Indian ocean; and if we mark on a

map the antipodes of all the points in North America, we should find that the whole of that continent is exactly antipodal to the Indian ocean. Similarly, the elliptical mass of Europe and Africa is antipodal to the central area of the Pacific ocean; the comparatively small continent Australia is antipodal to the comparatively small basin of the North Atlantic; the South Atlantic corresponds — though less exactly—to the eastern half of Asia; and the Arctic ocean is precisely antipodal to the antarctic land.

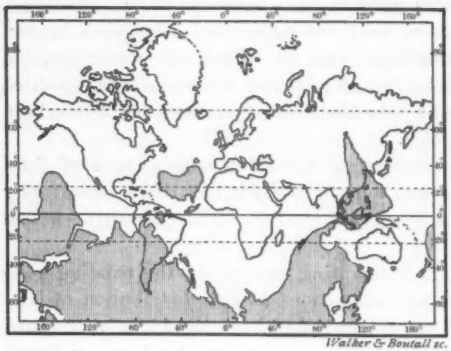


FIG. 1.—MAP OF THE WORLD, SHOWING THE DISTRIBUTION OF ANTIPODAL AREAS.

These, then, are the three fundamental facts in the existing plan of the globe. Our main problem is, Why are the geographical elements thus shaped and thus distributed?

The Earth's Concentric Shells.

It simplifies the statement of the problem to remember that the Earth consists of three parts: there is the vast unknown interior, or "centrosphere," concerning which physicists have not come to any unanimous decision, some saying that it is throughout solid and rigid, others that it is partly fluid, and others again that it is partly gaseous. This interior mass is enclosed by a shell formed of two layers, the solid crust, or "lithosphere," and the oceanic layer, or "hydrosphere." It is possible that at first the two layers of the shell were regular and uniform, in which case the whole world was covered by a universal ocean; but before the dawn of geological history, this arrangement had been disturbed by the formation of irregularities in the surface of the lithosphere. Dry land appeared at the areas of elevation, and the waters gathered together into the intervening depressions.

The problem, then, of the distribution of land and water on the globe is the problem of the distribution of irregularities in the surface of the lithosphere. We are accordingly at once brought face to face with the question, When were the existing irregularities made? If, as many authorities say, these depressions date from the earliest days of the Earth's history, and have lasted unchanged in position throughout geological time, then we are thrown back upon some cause which acted when the Earth was in its infancy. In that case the question is astronomical and physical, instead of geological and geographical.

Pre-Geological Geography.

There have been several attempts to solve the question astronomically, of which the most important is that of Prof. G. H. Darwin. According to his luminous theory, the tidal action of the Sun on the viscous Earth formed two protuberances at opposite points of the equator; one of the protuberances broke away and solidified as the Moon, which revolved round the Earth much nearer than at present. As a new equatorial protuberance formed the Moon pulled it backward, thus causing a series of wrinkles in the Earth's crust, which persist as the main structural lines of the continents. These wrinkles ran at first north and south from the equator. But, owing to the Moon's strong pull on the equatorial girdle, this part of the Earth would tend to revolve more slowly than the polar regions. Hence the primitive wrinkles were deformed; instead of being meridional in direction, they would trend north-easterly in the northern hemisphere, and south-easterly in the southern hemisphere. Prof. Darwin points out that some of the most striking geographical lines on the Earth run in accordance with this plan. He instances the eastern coast of North America, the western coast of Europe, part of the coast of China, and the southern part of South America. But, with characteristically Darwinian frankness, he does not overpress the facts, admits that the resemblances are not so convincing as they might be, and that some cases, *e.g.* the western coast of North America, are absolutely inconsistent with the scheme.

Another theory that attributes the formation of the main geographical lines to pre-geological incidents is given in a paper by Prinz, "Sur les similitudes que presentent les cartes terrestes et Planétaires," which elaborates and gives an astronomical basis to ideas previously suggested by Lowthian Green and Daubrée. His theory is that the northern part of the Earth had a lower angular velocity than the equatorial and southern regions. Therefore the land masses in the southern hemisphere were gradually pushed forward towards the east. The line between the northern retarded hemisphere and the southern swifter hemisphere is the great line of weakness and fracture that runs from the Caribbean along the Mediterranean, down the Persian gulf and across Malaysia. Prinz has drawn a map (Fig. 2) showing how the main geographical lines agree with his assumed lines of torsion.

This map is interesting, for these primitive torsion wrinkles must have been formed in the same period as Prof. Darwin's primitive tidal wrinkles. It is significant that the lines do not correspond. The chief geographical lines which Darwin claims as his primitive wrinkles are inexplicable on Prinz's theory, and the great lines which Prinz claims to support his wrinkling are opposed to those of Darwin. The geo graphical primitive lines of the two theories are often contradictory.

A third theory assigning the geographical distribution to very

ancient causes has been proposed by Prof. Lapworth. In an address to the geographical section of the British Association in 1892, and in a brilliant lecture on "The Face of the Earth," delivered to the Royal Geographical Society in 1894, Lapworth attributed the arrangement of oceans and continents to an intercrossing series of primitive earth-folds. The oceans, according to this theory, occupy ancient basins of depression; and the continental masses are domes of elevation.

"The surface of the Earth-crust at the present day," says Lapworth, "is most simply regarded as the surface of a continuous sheet which has been warped up by two sets of undulations crossing each other at right angles. . . . The one set ranges parallel with the equator, and the

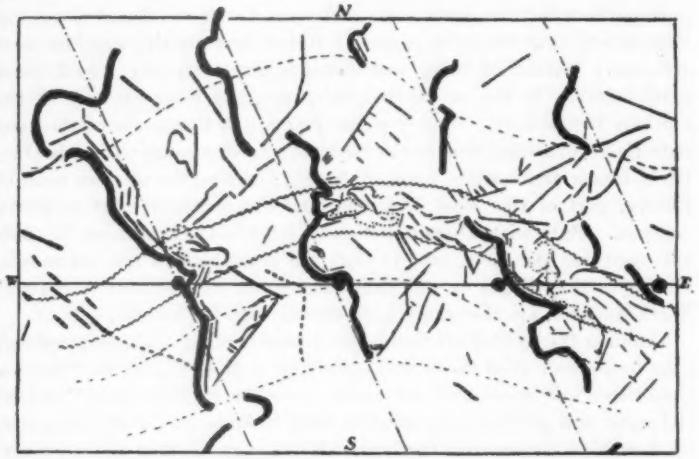


FIG. 2.—THE OBLIQUE COURSE OF THE MAIN GEOGRAPHICAL LINES. (AFTER PRINZ.)

other ranges from pole to pole." Prof. Lapworth contends that the intersecting of two simultaneous orthogonal sets of undulations explains the forms and dispositions of the continents, the triangular shapes of their extremities, the diagonal trends of their shores, and the course of the linear archipelagoes. In some interesting diagrams he suggests why the intersecting nodal lines which mark the divisions between the areas of elevation and of depression should coincide with the steep slopes that separate the ocean floors and the continental platforms; and why the existing shore-lines should so often run diagonally between the meridions and parallels.

This theory, and that of Sir John Lubbock, which also attributes the continental forms to a double intercrossing series of folds, have the advantage over the astronomical theories of more detailed agreement with geographical facts; but Prof. Lapworth has not, so far as I am aware, explained what caused his intersecting folds. His theory is accordingly

less complete than the others, as it is rather a statement of facts than an explanation of causes.

These suggestive theories are open to one objection which seems fatal to their application to the existing geographical plan. We should expect from them that the main geographical structure lines in the northern and southern hemispheres should be either symmetrically arranged or continuous on both sides of the equator. But that the land systems of the two hemispheres are asymmetrical is the most glaring fact in geography. It may be urged that the primitive folding, wrinkling and torsion formed a symmetrical or continuous land system, and that the asymmetrical arrangement is due to later movements. In that case the theories are geographically inadequate, because they give no explanation of how the existing geographical asymmetry was developed.

But there is another and still more serious objection which applies to all three theories. They not only explain too little, but they explain too much. The primitive lines of these systems often coincide with features of modern development, and are inconsistent with the old-established geographical arrangements. For instance, Prof. Darwin quotes the trend of the western coast of Europe from Spain to Norway as in accordance with his scheme. Prinz makes the primitive line here run exactly at right angles to Darwin's line; and geological evidence favours Prinz. The coast-line from Spain to Norway is almost certainly of modern date, while the lines of wrinkling, both Hercynian and Alpine, run transversely to the direction which they ought to have followed if due to tidal strain. Moreover, Prof. Darwin quotes the western coast of North America as inconsistent with his theory; but that coast is parallel to a line of primitive wrinkling, for there is an archean protaxis to the coast ranges and Rocky mountains.

Prinz's torsion wrinkles are no better. The most striking case of apparent agreement between his theory and geography is the trend of the Andes and Rocky mountains. Prof. Lapworth also lays stress on "the great Rocky Mountain-Andes fold . . . the longest and most continuous crust-fold of the present day." * The agreement was important so long as the Rocky mountains and the Andes were regarded as a single mountain system, connected into a continuous line by a mountain axis running north and south across Central America. But that axial mountain chain in Central America is a myth. Central America is traversed by a series of ridges which run east and west, and not north and south.† The watershed, it is true, runs along the Pacific border,

* The term "Rocky mountains" is here apparently used for the Sierra Nevada and Coast Range series of British Columbia. The true Rocky mountains are at a great distance (ranging up to 1000 miles) from the Pacific coast, the trend of which they do not determine.

† *E.g.* the Sierra Candela, Cordillera de Dota, Sierra Chiriqui, Sierra Veragua, Cordillera de San Blas, etc.

but that is due to a movement later than the mountain ridges which are thus truncated. The continuation of the Andes is in the mountains of Venezuela, not in North America or the Sierra Nevada. The Andes and the mountain system of the western states of America are essentially distinct; they differ in every important respect, geological structure, geographical characters, and dates of formation. Any theory which assigns the Andes and the great mountain series on the western coast of North America to a common origin is thereby prejudiced, instead of being supported.

FIG. 3.—THE MOUNTAIN SYSTEM OF CENTRAL AMERICA. *a*, VOLCANIC CHAIN OF HEREDIA; *b*, SIERRA CANDELLA; *c*, CORDILLERA DE DOTA; *d*, SIERRA CHIRIQUI; *e*, SIERRA VERAGUA; *f*, CORDILLERA DE SAN BLAS; *g*, VOLCANIC CHAIN OF ALAJUELA.

These three theories assign the Earth-plan to a venerable antiquity; but there is a fourth theory, which carries it back to an antiquity even more venerable. Lord Kelvin attributes the oceanic and continental areas to a chemical segregation in the gaseous nebula which was the parent of the Earth. According to this theory, "Europe, Asia, Africa, America, Australia, Greenland and the antarctic continent, and the Pacific, Atlantic, Indian, and Arctic ocean depths, as we know them at present," were all marked out in the primæval gaseous nebula. These gaseous continents condensed to liquid continents, marked off from the sub-oceanic areas by chemical differences; and these liquid continents were fixed as the solid continents, heightened by shoaling as the molten globe and its last lava ocean solidified.

That theory appears probable with one verbal amendment—the substitution of the term "archean-blocks" for continents. That these archean blocks—the Earth's great corner stones—were embryonically outlined by chemical segregations in the molten or gaseous stages of the Earth seems probable. But these archean corner stones, though the foundations of the continents, are not the continents. Lord Kelvin's theory suggests no explanation why chemical segregations should have assumed the shapes of the continents, so that his explanation rests on an unexplained cause; and even if his theory be amended by application to the archean blocks instead of to the continents, the theory is geographically insufficient, as it does not show the relation between the archean blocks and the existing continents.

The Permanence of Continents.

That Lord Kelvin's nebulous segregations, Prof. Darwin's primitive wrinkling, Sir John Lubbock and Prof. Lapworth's double folds are all true causes seems probable. What is doubtful is whether any extensive trace of their influence can be discerned in the present distribution of land and water. A map of the world in early Cambrian times might show the influence of these pre-geological incidents; but their geographical effects seem to have been obliterated by the changes of geological times.

Reference to such changes reminds us that we cannot assume their occurrence without considering the unending controversy as to the supposed permanence of oceans and continents.

There are, it must be conceded, many weighty arguments in favour of the permanence hypothesis. Many of the last great mountain foldings follow the lines of much older movements; and if the mountain axes, the "backbones of the continents," have occupied the same positions, why not also the continents moulded upon them? Again, some of the great mountain chains, such as the Andes, run parallel to the nearest shore-line, as if the movements that formed them had been deflected by the ocean basin.

The character of the ocean floors, moreover, suggests that they have never been continental, as they are at present covered by deposits not known in the interior of the continents; and as they are supported by material much heavier than that which forms the foundations of the continents.

These arguments, however, are not conclusive. Great earth movements of one date often cut obliquely and transversely across those of earlier periods. Thus the old north-westerly and south-easterly movements of France and Spain have been cut across by the east and western movements of the Pyrenean-Alpine system. Mountain axes have not always been deflected by or limited by existing ocean basins. Thus the north Atlantic basin cuts directly across the old Hercynian mountain chains, which may at one time have extended across the

whole Atlantic channel. This is rendered probable by three lines of evidence. Thus in north-western France, and in the south of the British Isles, there is a series of ranges trending north of west, which is cut off abruptly by the Atlantic slope. On the opposite shore of the Atlantic in Newfoundland, there is a similar series of truncated ranges formed at the same age as those of western Europe, and having the same trend. Bertrand maintains (1887) that the resemblance between the opposite mountain series is so striking that they should be regarded as parts of one mountain system, of which the central part has been sunk below the Atlantic. The well-known telegraph plateau on which the cables rest may mark the site of this sunken land. Palæontological evidence also supports the formation of the Atlantic by subsidence; for a shallow water, sub-tropical, marine fauna ranged from the Mediterranean to the Caribbean, and can only have crossed along a belt of shallow water in tropical or sub-tropical latitudes. Direct evidence of the existence of shallow water, continental deposits of the age required is given by the Azores, which, although now separated from Europe by a deep depression, contain shallow water deposits with fossils of the Mediterranean fauna.

Thus there is strong evidence to show that the Atlantic, in its present form, is of no great geological antiquity, and Suess' theory of its origin continually gains stronger support. Similar, though less complete, evidence shows that the other ocean basins have been broken up along certain lines, and emphatically denies their entire permanence throughout geological times.

Élie de Beaumont's "Pentagonal Reseau."

Hence, if the ocean basins were not formed pre-geologically, but have grown from the changes that have occurred during the long ages of geological time, then we must seek for a cause that has acted continuously, and is acting to-day. A more permanent cause is supplied by the contraction of the Earth's crust, as the globe gradually cools. Since the cold, hard crust is less plastic than the hotter interior, it is necessarily crumpled as it is forced into a smaller space.

This idea is well known, as it has been invoked by geologists to explain the formation of folded mountain chains. That the mountain systems of the world were formed by this agency is improbable; but it is perhaps still too much to say that it is impossible. For Prof. G. H. Darwin has suggested that the contractility of the rocky crust has been exaggerated, and it has been shown that Reade's level of no strain may lie much deeper than was at first thought.

That secular contraction is the direct cause of the great fold-mountain systems is however less widely believed by geologists than it once was; but it may have an important influence in determining their direction. The trend of the great chains of fold-mountains is to us a significant

question, because there is much truth in the phrase, proverbial since its use in 1682 by Burnet, in his 'Theory of the Earth,' which describes the mountain chains as the "backbones of the continents." The first geological attempt to explain the plan of the Earth was based on this belief. The author of this system was the French geologist Élie de Beaumont, whose theory of geomorphogeny was stated at length in his 'Notice sur les systèmes de montagnes' (3 vols.: Paris, 1852). This famous theory was based on a correlation of the mountain chains by means of their orientation. Élie de Beaumont accepts the view that the Earth consists of a thin rigid crust surrounding a fluid, solidifying interior. The crust being thin, it necessarily collapses as the internal mass contracts. He assumes that these collapses occur at intervals of time, and that at these collapses the crust is broken along lines of weakness, which are crumpled up into mountain chains. He assumes that for practical purposes the Earth's crust may be taken as homogeneous; hence that the fractures of the crust would be regularly distributed, and those of successive periods would cross one another along the lines of a regular symmetrical network.

Among the regular simple geometrical forms, that known as the pentagonal dodecahedron, which is enclosed by twelve equal regular pentagons, possesses an exceptionable degree of bilateral symmetry, *i.e.* it can be cut into exactly similar halves in an unusually large number of directions. Sections along any of the edges of any of the pentagons and through the centre of the pentagonal dodecahedron divide it into equal and similar halves. So also do sections from the centre of the pentagons to any of the angles, and likewise sections across the pentagons from alternate angles. Each face of a pentagonal dodecahedron may therefore be divided by fifteen planes of symmetry.

A sphere may be described upon the pentagonal dodecahedron, so that all the corners (or, to use the correct term, solid angles) occur in the surface of the sphere. By joining the corners by lines, the sphere is marked off into twelve spherical pentagons, which possess the same amount of symmetry as the plane pentagons. The lines where these planes of symmetry cut the surface of the sphere form a network of spherical triangles. Such a network Élie de Beaumont called his pentagonal network, and he used it in the following way. He studied the mountain ranges of the world, and by elaborate calculations showed their relative directions at a few localities which he chose as centres of comparison. He found that many mountain ranges have the same orientation, and that others cross the first set at definite regular angles. The directions of the different sets of mountain ranges coincide with the lines of his pentagonal network. Élie de Beaumont claimed that the mountains whose directions are parallel,* were formed

* For explanation and justification of this use of the word "parallel," see Hopkins, "Presid. Address, Geol. Soc.," *Quart. Jour. Geol. Soc.*, vol. ix. p. xxix.

at the same date. Successive mountain-forming movements raised chains parallel to different edges of the network; and thus the intersecting mountain lines of the world, and, consequently, the forms of the continents, were determined.

Élie de Beaumont had no difficulty in pointing out striking coincidences between important geographical lines and his pentagonal network. Thus the Mediterranean volcanic axis, passing through the Grecian archipelago, Etna, and Teneriffe, is parallel to the Alpine chain, and at right angles to the circle through Etna, Vesuvius, Iceland, and the Sandwich Isles. He was able to show a close geometrical relationship between those lines and the line of the Andes, with the pentagon that covers Europe. That the Earth is traversed by great intersecting lines is undeniable. *E.g.* Daubrée showed that the valley system of Northern France follows a line of rectangular fractures, which he called diaclases. The directions of the Greenland fiords is determined by a similar series of intersecting diaclastic fractures. Bertrand has shown that the movements in the Paris basin, the North sea, and English channel, have followed a double set of orthogonal intersecting lines.

But that the fracture lines or lines of weakness in the Earth's crust should intersect more or less rectangularly is natural on any theory of their formation. And such coincidences as those pointed out by Élie de Beaumont in support of his system are inevitable in so crumpled a globe as ours; but they are not sufficiently numerous to be convincing, especially in face of the fundamental differences between the facts of geography and Élie de Beaumont's elaborate artificial system. His theory could only be applied to a symmetrical world; * in a dodecahedron the opposite faces are always similar and parallel; in Élie de Beaumont's network the antipodal areas are always similar. But, as we have seen, the fundamental fact in the plan of the world is that opposite areas are dissimilar. In crystallographic language, the lithosphere is hemihedral, not holohedral; and no scheme based on a holohedral form will serve. It is the recognition of this principle that led to the next great advance.

The Tetrahedral Theory.

Élie de Beaumont's scheme is now mainly of historic interest, though Lefort's recent map of the Nivernais shows that it is still used as a working hypothesis by some French geologists. But Élie de Beaumont's theory marked an epoch in this subject, for it led to the system of Mr. Lowthian Green, which far better meets the requirements of the case.

This system was founded in 1875, by Mr. Lowthian Green, in a work

* This objection applies also to various later modifications of Élie de Beaumont's principle, such as those of Owen; or to the more than local acceptance of the diaclases of Daubrée, or orthogonal cross-folds of Bertrand.

which was neglected or ridiculed at the time of its appearance. Like his predecessor, Green assumes that the Earth is a spheroid based on a regular geometrical figure. He adopted as his base the apparently hopelessly unsuitable figure of the tetrahedron, which is contained within four equal similar triangles. This form, with its four faces, six sharp edges and four solid corners, does not conform to the ordinary conception of the figure of the globe. Any comparison between them looks ridiculous. But if we place a three-sided pyramid on each face of the tetrahedron, its proportions are nearer those of a globe; and if these pyramids had elastic sides, so that they could be blown out and the faces thus made curved, then the tetrahedron would become spheroidal and even spherical. Conversely, if a hollow sphere be gradually exhausted of air, the external pressure may force in the shell at four mutually equidistant points, and, by the flattening of these four faces, make it tend towards a tetrahedral form. Now the tetrahedral theory does not regard the world as a regular tetrahedron with four plane faces; it considers that the lithosphere has been subjected to a slight tetrahedral deformation, to an extent indeed only faintly (if at all) indicated by geodetic measurements, but yet easily recognizable owing to its influence on the distribution of land and water. As the centres of the flattened faces are nearer the Earth's centre of mass than the edges, the water will collect upon them. The ratio of the area of land to that of water on the globe is as 2 to 5. If on a model of a tetrahedron we colour the five-sevenths of the surface that is nearest the centre, the coloured areas would show where the water would collect if the Earth were a stationary tetrahedron. On the upper face there is a large central coloured area in the position of the Arctic ocean. It is surrounded by a land belt, from which three projections run southward down the three lateral edges. These three land areas taper southward

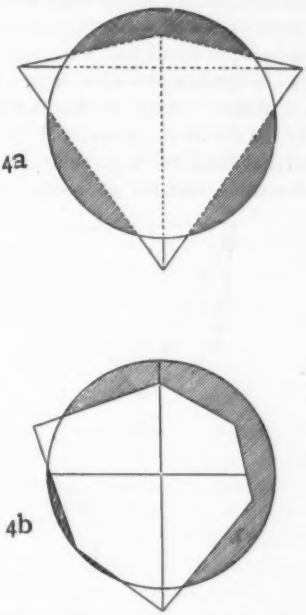


FIG. 4.—RELATIONS OF A TETRAHEDRAL LITHOSPHERE TO ITS HYDROSPHERE. FIG. 4a REPRESENTS THE ARRANGEMENT IN A SIMPLE TETRAHEDRON. FIG. 4b ILLUSTRATES THE CASE OF A MODIFIED TETRAHEDRON (SUCH AS SHOWN IN FIG. 5b), BY A SECTION PASSING ON THE LEFT THROUGH A TETRAHEDRAL COIGN, AND ON THE RIGHT THROUGH THE OPPOSITE TETRAHEDRAL FACE. THE SHADED AREAS REPRESENT WATER.

to a point, below which is a complete belt of sea. South of that, again, is our fourth projecting corner, which is above the water-level, and is the Antarctic continent. So that on the model the general plan of the arrangement of land and water is identical with its actual distribution on the globe. For the land occurs as three triangular equidistant continents, united above into a ring and tapering southwards; there is a great excess of water in the southern and of land in the northern hemisphere; and land and water are antipodal, since in a tetrahedron a corner is always opposite a flat face.

But of course in the Earth the faces are not flat, but are convex. If the flat faces be replaced by projecting pyramids with curved faces, so that the form is globular, the arrangement of land and water remains the same, but the shore-lines are more complex. Green has shown

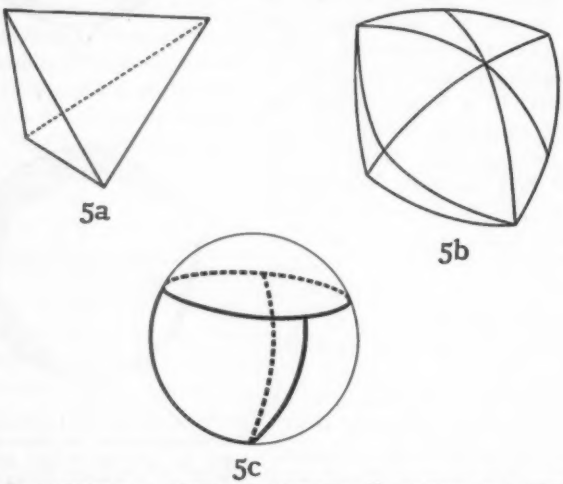


FIG. 5.—5a, DIAGRAM OF A SIMPLE TETRAHEDRON.—5b, DIAGRAM OF A TETRAHEDRON WITH A SIX-FACED PYRAMID WITH CONVEX FACES ON EACH OF THE FOUR FACES.—5c, THE TRACE OF THE TETRAHEDRAL EDGES ON A SPHERE; THE THICK LINES SHOW THE POSITION OF THE TETRAHEDRAL EDGES.

what the shapes of the land and water areas would be in such a tetrahedron. The resemblance between his diagrammatic continent and Africa and S. America, and between his ocean and either the Pacific, Indian Ocean, and S. Atlantic, is very striking.

The Tetrahedral Course of Geographical Lines.

The agreement between the facts of geography and the tetrahedral theory goes further. The four faces of a tetrahedron meet along six edges, which should be lines of elevation on a globe. The trace of the edges of a tetrahedron on a surrounding sphere form a circle in the

northern hemisphere, and three vertical or meridional edges meeting at the south pole. In the Earth the major watersheds have exactly this arrangement. The great watershed of Eurasia dividing the northern and southern drainages, runs, not along the main mountain axis, but far to the north of it, between the parallels of 50° and 60°. The northern and southern slopes of North America are separated by a divide along the same latitude. The southern watersheds, instead of following the lines of highest mountains, or the middle line of the continents, run close to the coast-lines; the three watersheds mark the three vertical tetrahedral edges, and they occur at almost the theoretical distances, 120° apart.

Similarly with the mountain chains. As Sir John Lubbock has pointed out, "in the northern hemisphere we have chains of mountains running east and west—the Pyrenees, Alps, Carpathians, Himalayas, etc.—while in the southern hemisphere the great chains run north and south—the Andes, the African ridge, and the grand boss which forms Australia and Tasmania." That is to say, the northern mountains are parallel to the upper edges, and the southern mountains parallel to the meridional edges of the tetrahedron.

The Cause of the Tetrahedral Plan.

The statement that the elevations of the lithosphere are tetrahedral in arrangement is not an hypothesis, but a simple statement of geographical fact. Is the fact a mere coincidence? On the contrary, there are good reasons why the Earth should acquire such a tetrahedroid symmetry. When the Earth solidified, it would (neglecting the influence of rotation) have contracted into a spherical shape. It would have tended to acquire this form because the sphere is the body which encloses the greatest volume for a given surface. But as the Earth contracts it tends to acquire a shape in which there is a greater surface in proportion to its bulk. Now, among the regular geometrical figures with approximately equal axes, the tetrahedron is that which contains the smallest volume for a given surface. Hence every hard-shelled body which is diminishing in size, owing to internal contraction, is constantly tending to become tetrahedral in form. Fairburn's experiments (quoted by Green) illustrate this tetrahedral collapse for short tubes; and that it is considered probable by some geodists is shown by the following quotation from E. D. Preston: "Nothing is more in accordance with the action of physical laws than that the Earth is contracting in approximately a tetrahedral form. Given a collapsing homogeneous spherical envelope, it will assume that regular shape which most readily disposes of the excess of its surface dimensions, or, in other words, the shape that most easily relieves the tangential strains; for, while the sphere is of all geometrical bodies the one with a minimum surface for a given capacity, the tetrahedron gives a maximum surface for the

same condition. Experiments on iron tubes, on gas-bubbles rising in water, and on rubber balloons, all tend to bear out the assumption that a homogeneous sphere tends to contract into a tetrahedron."

The Earth a Geoid.

But it may be said this tetrahedral theory is impossible, because we know from our elementary text-books that the Earth is not tetrahedral, but is an oblate-spheroid—that is to say, a sphere slightly flattened at the poles.

The oblate spheroid is no doubt the form that rotation would have caused the Earth to assume as it solidified, if the Earth were quite homogeneous. But the Earth is not homogeneous; it varies in strength and density, and an unequal load on the Earth in any area leads to a divergence there from the circular shape. It is, I believe, now universally admitted that the Earth is flattened laterally at the equator as well as at the poles. The question was long disputed between the astronomers, who, from theoretical considerations, declared what the shape of the world ought to be, and the geographers, whose measurements showed what the shape actually was. There is now a general agreement that the geographers were right; that the equatorial section of the Earth is elliptical, similar to a section through the Earth passing across the poles. The Earth is therefore not a true spheroid, and it was accordingly regarded as an ellipsoid with three unequal axes. But there is good reason to believe that the Earth is not even an ellipsoid; for the northern and southern hemispheres are unlike, and the Earth is therefore shaped like a peg-top. This is shown in two ways. It is a well-known property of the ellipse that degrees measured along the flatter side are longer than degrees measured near the sharper end. It was by proving that a degree of latitude in Lapland is longer than a degree of latitude in Ecuador that the French astronomers in the seventeenth century definitely proved the Earth's flattening at the poles. In continuation of these observations, La Caille, in 1751, measured the length of a degree at the Cape of Good Hope. His measurements showed that the southern hemisphere was also flattened, but to a different extent than the northern hemisphere. This anomalous result of La Caille's was confirmed and extended by Maclear.

The inequality of the two hemispheres has also been shown by the variations of gravity in the two hemispheres, which, as it is more easily tested, has been more widely applied. The principle is simple. A pendulum swings more rapidly the nearer it is brought to the centre of the earth. A pendulum swings more slowly on a mountain-top than at sea-level. It was because Richer, in 1672, found that a clock which kept correct time in Paris lost two minutes a day in French Guiana that the polar flattening was first suspected. So many observations have been made that maps have been compiled showing the variation of the

force of gravity throughout the globe. Fig. 6 is a copy of Steinhauser's map, in which the variation of gravity is illustrated by showing how many millimetres have to be added to the length of a pendulum which beats seconds at the equator, to make it vibrate at the same rate elsewhere. In both northern and southern hemispheres the second-beating pendulum has to be steadily lengthened as we approach the poles, but the deviation is at a different rate for the two hemispheres. The surface of the southern hemisphere does not approach the Earth's centre of mass at the same rate as the northern hemisphere. If the Earth's centre of mass is at its geometrical centre, then the Earth's form is elongated southward like a peg-top.

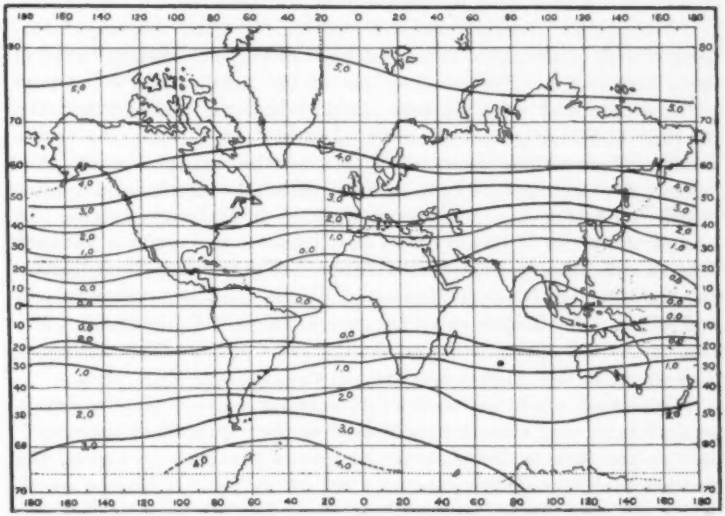


FIG. 6.—STEINHAUSER'S MAP, SHOWING VARIATION IN ATTRACTION OF GRAVITY, AS INDICATED BY LENGTH OF THE SECOND-BEATING PENDULUM. 0 = LENGTH IN EQUATORIAL BELT; 1–5 = NOS. OF MILLIMETRES BY WHICH PENDULUM HAS TO BE LENGTHENED IN ORDER TO BEAT SECONDS AT DIFFERENT LATITUDES.

It is often held that the Earth's centre of mass is to the south of its centre of form, because of the accumulation of water in the southern hemisphere. It is held that the water is piled up there, owing to the greater density of the southern hemisphere. If that be the case, then the peg-top elongation is all the greater.

Moreover, there is evidence to show that the Earth's figure is still more irregular than that of a peg-top.* Sir John Herschel, although taking the astronomical side in the controversy, aptly stated the facts in the statement that "the Earth is earth-shaped." Listing's name of geoid,

* As Prof. Darwin suggests, potato-shaped would be a more correct simile.

which expresses this view, has now supplanted the old oblate spheroid from everything except the text-books. That there are local deformations in the Earth's shape is demonstrated by the differences between the astronomical and trigonometrical determination of positions. Places have two different longitudes, the astronomical longitude obtained by astronomical observations, and geodetic longitudes determined by terrestrial measurements; the differences are often considerable. It was calculated, *e.g.*, that the trigonometrical and astronomical determinations of the stations used in the delimitation of the Canadian and United States frontier should have agreed within 40 feet, or 0·4 of a second of arc; but the average error was more than five times as great, and ran up to eighteen times as much as it should have been.

Astronomical determinations, moreover, are often not only inconsistent with geographical measurements, but they are often inconsistent with themselves. For example, one of the most refined estimations of longitude that have yet been attempted, is the series undertaken by the "K. K. topographische-militär Institut" of Vienna. To ensure accuracy during these observations, the most elaborate precautions were taken. Corrections were even made for the effect of the doses of quinine which the astronomers took when working in malarial climates. In one of the series of observations, the difference in longitude between Vienna and Milan was determined first directly, and then by determining the difference between Vienna and Brescia and that between Brescia and Milan. But in spite of all the care, the results did not tally. The sum of the two differences was not the same as the single difference. The whole, in fact, in this case was less than the sum of its parts.

To astronomers it may seem an unnecessary waste of time to devote so much to proving these deformations from the "spheroid of reference." But as the idea is less familiar to geographers and geologists, the insistence on this deformation may not be useless. It may be worth while adding a quotation from Prof. C. A. Young,* to show that the spheroid of reference is only a convenient assumption. "On the whole," says Prof. Young, "astronomers are disposed to take the ground that since no regular geometrical solid whatsoever can *absolutely* represent the form of the Earth, we may as well assume a regular spheroid for the standard surface, and consider all variations from it as local phenomena, like hills and valleys."

As deviations from the assumed spheroid of reference exist, it remains to inquire whether there is any evidence that they agree in position and arrangement with the theory of the tetrahedral deformation of the lithosphere.

The evidence already quoted of the dissimilarity between the northern and southern hemispheres and the elongation of the latter, is geodetic

* C. A. Young, 'General Astronomy,' p. 101. 1889.

proof of the northern flattening and the antarctic projection, *i.e.* of one face and one tetrahedral corner.

The three flattened lateral faces and three projecting vertical edges are sufficiently demonstrated by the three great oceans and the land-lines that divide them. Practically, all the theories agree upon that point. It is well known that gravity is greater than was expected at most oceanic islands. Lallemand and de Lapparent have suggested that this is due to those islands being below the level of the ordinarily accepted figure of the Earth, and therefore nearer the Earth's centre of gravity.* Fisher has suggested that the Pacific Ocean is the hollow left by the loss of the material which forms the moon. Faye has explained the ocean basins and the greater density of the crust below them as due to more rapid refrigeration below the cold oceanic abysses. According, therefore, to Faye, the rocks below the oceans contracted more than those below the continents, became denser, and accordingly sank.

Thus from all points of view the three oceans represent areas of depression, and the three land-lines of South America, Africa, and Australasia mark intervening projections. The oceans mark the low areas in the lithosphere as obviously as the bubble of a spirit-level marks its higher end; and they give, therefore, evidence of the triangular lateral flattening of the southern half of the globe.

But as, on the mathematical figure of the Earth, such lateral flattening is more improbable than variations along the axis of rotation, let us consider whether there is any geodetic proof of these flattened faces and projecting edges.

There has been a long controversy as to whether Bessel's or Clark's ellipsoid better represents the figure of the Earth. Clark's figure was the later in date, and is generally considered as the more exact. Helmert therefore expresses some surprise that the gravitational observations in Central Europe along the 52nd parallel of north latitude agree with Bessel's curve better than they do with Clark's; this is the case all across the area on which Bessel's own work was done. But as soon as we get into the Volga basin, the gravity line diverges from Bessel's curve and approaches that of Clark. The change comes due north of the Eurafrican meridional edge. The anomalies are at once removed if we assume that both ellipsoids are locally correct; that Bessel's curve is true for Europe, and Clark's correct for Asia; and that the two merge into one another north of the line of the Eurafrican tetrahedral edge.

On the tetrahedral theory, there ought to be a projection north of this tetrahedral edge. And gravity determinations show a great deficiency

* This explanation is inadequate, as it does not explain the deviation of the pendulum on coast-lines towards the ocean. The excess vertical attraction of the islands has been explained as due to the attraction of the mass of the island and its base.

in gravity in Western Russia in an appropriate area along the Volga basin. It is true that the figures have been queried. There is a natural tendency to query all facts that do not agree with theory, and the notes of interrogation in this case may illustrate that tendency. But on the view that there is an upward deformation of the Earth in this area, the anomalous deficiency in gravity observations is at once explained.

It may be replied that the existence of a normal gravity attraction at Moscow negatives the assumption of a superficial deformation; but the relative excess of attraction there is possibly due to the outcrop of Palæozoic rocks, of greater density than the loose sediments of the Russian lowlands.

Passing from Russia to the area in North America, where the next tetrahedral corner should occur, there is another area of deficient gravity, which may also be due to that area being a tetrahedral elevation. The deficiency is explained by the assumption of vast subterranean blocks of very light material. But that explanation is prohibited in the Russian case, since, as Helmert has shown, the deviations of a plumb-line from the vertical are inconsistent with the existence of such blocks. In reference to the North American case, Helmert has remarked that the light subterranean blocks must descend for several kilometres; and Mildenhall has shown that no reasonable assumption will suffice to explain the facts.

It would be too much to claim that geodetical evidence at present available proves the tetrahedral theory, for accurate data are not yet available for a sufficient proportion of the Earth to show whether the major deviations are based on a regular plan; but papers, such as that of Mr. E. D. Preston, show that geodesists are more inclined to regard the theory with favour. It is at least clear that geodesy does not disprove the hypothesis, and that some puzzling geodetic anomalies receive a simple solution if the theory be true.

Geology and the Tetrahedral Coigns and Edges.

Let us now turn to geology, to see if its evidence as to the past history of the world refutes or supports the theory.

The geological evidence ought to be of especial value, as we should expect it to determine the position of the tetrahedral coigns on the face of the Earth.*

If the tetrahedral theory be true, the four tetrahedral coigns should be areas of unusual stability and strength. Comparison of the three meridional land-belts shows that each of them begins in the north with a vast block of archean rocks. The Eurafrican zone, in longitude 20° E., begins with the block occupying Scandinavia, Finland, and Lapland, which Suess has termed the "Scandinavian schild." It is an area of

* They were assigned to their geometrical positions by Green, and in the interesting recent tetrahedral volcanic map of M. Michel-Lèvy.

great geological antiquity, which has long remained above sea-level; bands of marine deposits of different ages sweep round it, but the block may never have been below sea-level. It has unquestionably remained as a solid impassive block, which has dominated the whole geological history of Northern Europe. South of the Scandinavian coign are the transverse east and western chains of the Alps and the Atlas, with the Mediterranean trough between; and far to the south we have the old plateau of South Africa.

Let us now go 120° westward to the American zone. It begins with another block of old archean rocks, forming what Suess has called the "Canadian schild." It occupies Canada, Labrador, and most of Hudson bay and Baffin's Land, and underlies Greenland. Bands of marine deposits surround it, but it has perhaps never been itself below sea-level; its geological age, at any rate, is enormous. South of the North American coign we have again a pair of east-west mountain chains, forming the highlands of Cuba and Venezuela, separated by the Caribbean trough. This zone also ends southwards in an old plateau resting on archean rocks.

The third meridional zone repeats the same characters. It begins with a block of archean rocks, for which we may speak as the "Manchurian coign." South of this coign are the east and west ridges of Malaysia and the depressions parallel to them; and south of that, again, we have the archean plateau of Australia.

The three main land axes of the world have remarkable resemblances in structure, and they present three equidistant blocks of great stability at the three tetrahedral corners. We may, therefore, speak of the "schild" as the three northern coigns or corner-stones of the Earth.

The existence of these massive coigns* at the three tetrahedral corners has produced one point of divergence in the Earth-plan from the geometrical figure of the tetrahedron. The existence of three such broad massive blocks naturally strengthens the line between them; and, as we have seen, the main divide in the northern hemisphere runs from coign to coign. The tetrahedral edges would naturally be lines of weakness and of movement; but in the northern hemisphere, the horizontal lines of yielding are deflected southward by the stability of the band supported by the Earth's three northern coigns. Hence the great band of disturbances is subtropical, and runs from the Caribbean to the Mediterranean, across the Persian gulf and the Malaysian archipelago.

In the case of the vertical edges, however, the agreement in position, as well as direction, is exact. Precisely below the three corner blocks, there are three lines of instability coinciding with the vertical tetrahedral

* The suggestion of the word "coign" for "corner" I owe to Mr. L. Fletcher, to whom I am indebted for much helpful advice. The term is suitable, as it is used for a printer's wedge as well as for the corner-stone of a house.

edges. Below the Canadian coign there is the line of the Andes (long. 75°), which, according to some geologists, is still undergoing elevation. Almost 120° east of the Andes, and below the Scandinavian coign, is the Erythrean rift-valley (mean long. 40°), in which some of the Earth-movements are unquestionably of very recent date. Again, nearly 120° eastward, and due south of the Manchurian coign, is the recent line of movement represented by the eastern coast of Australia.

The main mountain system of the world corresponds, then, in direction or position, or in both, with the edges of the tetrahedron. The mountain lines run east and west in the northern hemisphere, and run meridionally in the southern hemisphere—that is, always parallel to the tetrahedral edges.

But it will be said there are three great exceptions, for the Ural mountains, the Appalachians, and the Rocky mountains are meridional instead of transverse, and that they therefore contradict the scheme. The contradiction is only apparent. The existing mountain ranges date from two main periods of mountain-building—the Upper Cainozoic and the Upper Palæozoic. The Upper Tertiary system includes the Alps, Andes, Himalaya, Pyrenees, Caucasus, and Atlas, etc. The Urals, Rocky mountains, and Appalachians belong to the Upper Palæozoic system. Before we can say whether these chains confirm or refute the tetrahedral theory, we must determine the distribution of land and water at the time when they were made.

Now, we know that in upper Palæozoic times one land fauna and flora ranged round the southern hemisphere from Australia to India, and thence to the Cape and South America. Instead of there having then been a continuous ocean-belt separating triangular points of land, there was then a southern land-belt, which was supported by three great equidistant corner-stones, the archean blocks of South Africa, of Australia, and of Patagonia and the Patagonian platform.

What the south pole was doing then is hidden by our deplorable ignorance of that area; but there is evidence that to the south of this southern land-belt there was a cold, ice-laden sea.

Now let us consider the state of affairs in the arctic regions at the same period. At the present time the mollusca of the Behring sea and North Atlantic belong to two essentially distinct faunas. But in upper Palæozoic-Triassic times, one fauna occupied both regions, and that fauna moreover extended uninterruptedly round the northern hemisphere, and apparently, along certain lines, extended some distance to the south. There was, in fact, a northern ocean-belt, which apparently surrounded a cold arctic land. The distribution of the land and water was then on the same plan as at present, but with land and water exactly reversed. There were two opposite interlocking belts of land and sea, the former based on three archean corner-stones, the latter projecting toward the equator between three archean plateaux.

Thus the plan was the same as at present, but the conditions were reversed. This gives us the clue to the mountain chains of the same period. That also was a double system. There was a sub-tropical mountain girdle, the ruins of which we can trace right across the old world from Eastern China to Western Europe, where it is cut off by the Atlantic slope. And projecting meridionally from that equatorial girdle, opposite the three coigns, we have three mountain ranges running along the meridional edges. These are the Ural mountains (60° E.) north of the eastern continuation of the South African coign, the Appalachians (80° W.) north of the western part of the old Patagonian coign, and the old broken axis of Kamtschatka (160° E.) north of the coign of Australasia.

Deformation and Recovery.

Such a change in the position of the flattened faces is by no means improbable in the case of a revolving globe. In the case of a stationary body, a tetrahedral deformation once begun would be strengthened by every fresh contraction. But owing to the world's rotation, the tetrahedral collapse is steadily resisted, and confined within narrow limits. The deformation formed by one period of slow, quiet contraction may be lost on the restoration of equilibrium at an epoch of great crustal disturbance. When deformation begins again in consequence of renewed contraction, the flattening may occur elsewhere.

This hypothesis of the alternation of periods of deformation with periods of spheroidal recovery is geologically useful, as it suggests an explanation of a certain periodicity in geological phenomena. For instance, the later half of Palæozoic time may have been a time of slow tetrahedral collapse, culminating in an instability which led to the great mountain movements which closed the Palæozoic; then followed a quiet period of slow restoration of the spheroidal form, causing the series of marine "transgressions" which are the dominant feature of the geological history of the Mesozoic era.

Vertical Range of Deformation.

Reluctance to admit the possibility of such changes is reduced when we recollect how insignificant are the differences in level, when compared with the size of the Earth. The use of exaggerated diagrams leads to unconscious magnification of the extent of the polar flattening, and of the difference between the continental summits and the oceanic depths. The study of large-scale maps has been authoritatively recommended. The examination of true scale curves and outlines may help us to realize the actual conditions. The accompanying figure * shows a section of the Earth's crust from Stromboli to Vesuvius. The thick black band represents the section across the Mediterranean; the line *ab* marks the depth

* Based on Lingg's 'Erdprofil.'

of the Atlantic; the upper curve shows where the surface would be if there were no polar flattening. The lowest line marks the depth of one-hundredth of the Earth's radius. The thickness of this zone in comparison with the size of the Earth is shown on Fig. 7, *b*, which is a

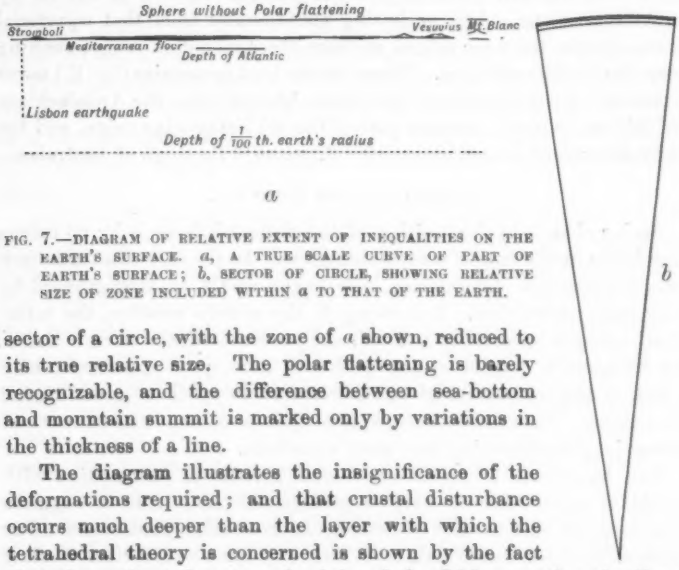


FIG. 7.—DIAGRAM OF RELATIVE EXTENT OF INEQUALITIES ON THE EARTH'S SURFACE. *a*, A TRUE SCALE CURVE OF PART OF EARTH'S SURFACE; *b*, SECTOR OF CIRCLE, SHOWING RELATIVE SIZE OF ZONE INCLUDED WITHIN *a* TO THAT OF THE EARTH.

sector of a circle, with the zone of *a* shown, reduced to its true relative size. The polar flattening is barely recognizable, and the difference between sea-bottom and mountain summit is marked only by variations in the thickness of a line.

The diagram illustrates the insignificance of the deformations required; and that crustal disturbance occurs much deeper than the layer with which the tetrahedral theory is concerned is shown by the fact that the estimated centre of origin of the Lisbon earthquake lies far below.

This diagram also serves to show that the amount of contraction in the Earth necessary to allow tetrahedral deformation is very small. This is important because, as Lord Kelvin has shown, the amount of contraction allowable during the later stages of the Earth's history is very limited. But geologists have the authority of Prof. Darwin for accepting a certain amount of contraction. "A cooling celestial orb must contract by a perceptible fraction of its radius after it has consolidated," he tells us, and his considerations "only negative the hypothesis of any large contraction of the Earth since the Moon has existed." * And, unlike the contraction theory of the origin of mountain chains, the theory of the tetrahedral deformation of the lithosphere requires only a small amount of radial contraction.

Finally, it may be urged that even such deformation as the tetrahedral theory requires is impossible, since physicists have taught us that the Earth is rigid. To this objection it is only necessary to

* *Phil. Trans.*, vol. 170, pp. 522, 523.

reply that Lord Kelvin's rigidity arguments apply to the Earth as a whole, and not to its crust; they deny the fluidity of the interior of the Earth, and do not prohibit any local deformations of the exterior crust. The once prevalent astronomical belief in the absolute invariability of the Earth's shape and in the absolute fixity of its axis of rotation (expressed, *e.g.*, by Sir J. Herschel in 1862) no longer hinders progress. In fact, astronomers tell us that, instead of the absolute fixity of the pole, it now shifts its position to an appreciable extent under the influence of the movements of the atmosphere, the unequal melting of the polar ice, and by heavy falls of snow on the Siberian highlands. These movements of the pole are important, because they are taken to prove a certain elasticity in the Earth. The movements demonstrated by actual observations are so far minute; but they at least allow geologists to say that, as such slight causes as those mentioned produce appreciable effects, more powerful causes acting for longer periods would work greater changes.

SUMMARY.

The object of the paper is to show that the old belief in a definite plan of the Earth is justified, since the distribution of land and water on the globe has been determined by the tetrahedral arrangement of the elevations and depressions in the surface of the lithosphere.

This tetrahedral plan is shown by the existence of (1) a northern land-belt, surrounding a northern ocean, and giving off three meridional land lines, which taper southward; (2) the southern ocean belt surrounding a south polar continent, and the three meridional oceans; (3) by the antipodal position of land and water; (4) by the course of the main watersheds and mountain chains.

It is held that this arrangement was not established in the Earth's infancy, and therefore has to be attributed to some agency which has acted throughout geological history.

There are reasons for believing that a contracting sphere with a hard crust would undergo tetrahedral deformation, and the evidence of geodesy shows that the Earth has been deformed from its spheroidal form. Its present figure may be defined as a geoid, which has been derived from a spheroid by irregular tetrahedroid deformation.

If such tetrahedral collapse be granted in the case of the Earth, then the existing arrangement of oceans and continents receives a natural explanation.

The changes in the distribution of land and seas in the past may be explained as due to the conflict of two opposing forces, collapse caused by the Earth's contraction producing deformations, which are reduced by the effects of the Earth's rotation. Geological history affords evidence of the alternation of periods of tetrahedral collapse and spheroidal recovery.

The plan of the Earth may, in short, be attributed to the continual foundering of the Earth's external shell, owing to the unceasing shrinkage of its internal mass.

After the reading of the paper, the PRESIDENT said: In inviting the discussion of this paper, I believe that there are those here who have given some thought to the subject, and who will at least be inclined to tell us what their impressions are respecting the views set forth in Dr. Gregory's paper. I hope Sir John Murray for one will be disposed to give us the result of his impressions on the subject, and also Mr. Blanford.

I find there is a reluctance on the part of learned men to commit themselves to any opinions on a question which at present is in its infancy, and on which their views are not entirely settled. I think that some parts of the paper might have been discussed, and I cannot help expressing, as I have done on other occasions, my regret at the loss we have sustained in our lamented friend General Walker, for there is no man who could have spoken with so much authority on one or two points, especially on the very slight differences that have occurred between astronomical observations and geodetic measurements. As Mr. Whittaker, the President of the Geological Society, is present, perhaps he would be disposed to address us.

Mr. WHITTAKER: I came to listen, not to speak. I found a little time ago that many gentlemen have come here after having the pleasure of seeing the proof. I am not one of those, and were I to speak it would be without the advantage they have had; consequently they would have the pleasure of sitting upon me, and this goes against my feelings. I would offer one general remark—it is the satisfaction I feel with any paper of this sort that shows the interdependence of the various sciences, and how men who follow one branch of science should not have too much of that branch alone, but should see occasionally how it bears on others, and, on the other hand, how others bear on it. This calls in geologists, physicists, mathematicians, and many others, and it is too big to take up without a chance of going into the matter beforehand, and I decline to commit myself to details.

It is uncomfortable to think that, instead of being on a comfortable globe, as we had imagined, one is placed on a tetrahedron.

Mr. VAUGHAN CORNISH: The tetrahedral theory was described by Mr. Lothian Green. When it was first promulgated it attracted very little attention, and no favourable attention; it was met almost with ridicule, and I think that it is, perhaps, not the smallest part of our indebtedness to Dr. Gregory that his great power of exposition has brought this theory again before the world, and though he has not yet secured for it a universal assent, he has at least secured a very careful consideration of what must, at all events, be considered a most substantial hypothesis. I think those who have followed carefully the able exposition of Dr. Gregory given to-night, must admit that the tetrahedral convention, at all events, represents the observed distribution of land and water upon the surface of the globe. That distribution is essentially hemihedral, as they say in crystallography; the forms are not whole forms, but two half-forms interpenetrating, as we see in the oppositely directed wedges of the continents and oceans, and so far, I think, we shall most of us be prepared to go with Dr. Gregory. With regard to the physical causes which have produced such a deformation of the assumed spheroid, I think most of us will wish to reserve our judgment until mathematicians and physicists and followers of experimental science have tested it quantitively, and have seen whether these causes, which I suppose would go in the direction of producing

tetrahedral, or tetrahedroid, deformation, are sufficient to produce the effects that Dr. Gregory has described.

The PRESIDENT: I think we shall all be agreed that this difficult subject, about which so few people seem inclined to give an opinion, has been set before us in a very clear and graphic manner and with great ability by our friend Dr. Gregory. I am sure you will all be ready to pass a vote of thanks for his most interesting paper. Although we are now almost for the first time realizing that the shape of the Earth is not what it is said to be in the text-books, we may remember that the first person who supported the theory that the Earth was the shape of a peg-top or a pear was Christopher Columbus, although he did not put the pointed end of the pear at the south pole, but near the region where the Venezuelan arbitration is going to take place. I now wish to ask you to pass a cordial vote of thanks to Dr. Gregory for his paper.

EXPLORATIONS IN ICELAND DURING THE YEARS 1881-98.*

By Dr. TH. THORODDSEN.

WHEN I was asked to write a brief account of my explorations in Iceland, together with a *résumé* of the geography of the island, I felt that in complying with the request I was undertaking a task which was anything but easy of fulfilment. To compress the results of seventeen years of observation and study into the compass of a short article is to lay one's self open to the charge of being superficial or sketchy, dry or dull. I therefore crave at the outset the reader's indulgence for merely touching upon several topics which, if only they could be treated at greater length, would almost certainly gain in clearness. For the sake of such as take an interest in the geography of Iceland, I will cite, in a series of footnotes, the sources which contain the accounts of my various investigations and journeys throughout the island. As those papers likewise give full information about both the geographical and geological investigations of other authorities, I trust that this present paper, although short, will serve as a sort of key to all that has been done in the field of Icelandic exploration. My own labours are scattered through many different periodical publications, some of them not readily accessible. Unfortunately, I have not hitherto been able to command the time to gather up my results into works of a more ambitious character. It will require several years for me to digest and work out properly the vast amount of scientific material of every kind which I have collected in the course of my journeys. I trust, therefore, I shall not be considered presumptuous if in this article I make bold to refer to those portions of my labours which I have been able to place on record in this or the other publication.

---

* Translated by J. T. Bealby, B.A. A new map of Iceland, from data supplied by Dr. Thoroddsen, will accompany the second instalment of this paper.

Although Iceland lies comparatively close to Europe, and although it possesses natural features which are in many respects remarkable, it cannot be said that the island is at all well known, certain relatively small portions of it alone excepted. Merely a fractional part has been visited by scientific inquirers. The majority of the visitors to Iceland follow the beaten tracks through the more accessible districts. Very few have enjoyed either time or opportunity to penetrate into the uninhabited and desolate interior. And there are many of the more inaccessible parts of the coast quite as much unvisited as the central region.

That Iceland has never previously been thoroughly examined is due to a variety of causes—its vast extent, its peculiar physical features, the sparse population, the unfavourable climatic conditions, the limited portion of the year during which it is possible to carry on investigations.

The uninhabited interior of the island, constituting more than one-half of the entire area, lies at an elevation of 1500 to 3000 feet above the level of the sea. The surface is covered by lavas, rocky *débris*, drift sand, and jökler, or ice-mountains. At such an altitude, so near the polar regions, the climate must necessarily be harsh. Vegetation is extremely scanty; for many miles on end there is not a blade of grass for a horse to pluck. It is also very difficult travelling in certain of the remoter portions of the coast, owing to its stern and rugged character. On the other hand, it is the easiest thing in the world to travel through the relatively thickly peopled districts of the south and the north; both are, in fact, visited every year by a respectable number of tourists.

Before we could say that this island was tolerably familiar to us two things were essentially necessary; first, a systematic geographical examination of the uninhabited interior; secondly, a geological reconnaissance of the entire island. It is true that several distinguished geologists have at different times visited Iceland, and published admirable accounts of what they have seen and observed; it is also true that certain particular districts have been examined again and again. Nevertheless, these inquirers have seldom spent more than a short time in the island, and consequently have gone away leaving vast stretches of it altogether unexplored. We possessed no general description of the geological structure of the island as a whole; nor, indeed, could we possess such, seeing that upon four-fifths of its surface no trained geologist had ever set foot. What was needed, then, was a general view of the physical geography and geological history of Iceland.

In the year 1881, I conceived the idea of trying to fill up piece by piece some of the biggest gaps in our knowledge of the geography and geology of Iceland. Considering the extremely modest resources I had at my command, I could scarcely hope to examine the entire island. The task I set myself was to go systematically to work, and, instead of

making a hasty survey of a large area, to confine myself to relatively narrow districts, examining one or more every year as thoroughly as I was able. By adopting this plan, I hoped, with patience, to gain a tolerably accurate knowledge of some of the less-known quarters of the island; and, time and opportunity favouring me, I might possibly go on, and in this way gradually lay the foundations for a general survey of the whole country.

The first nine years I was sadly hampered through lack of means; but as time went on, this hindrance was gradually removed. First, the Icelandic Althing made me a grant. After that the Danish Rigsdag and two private gentlemen—Mr. Oscar Dickson, of Gothenburg, and

DR. THORODDSEN AND MR. SIGURDSSON STARTING.

Mr. A. Gamél, of Copenhagen—generously provided me with the means to procure a better equipment; so that I was enabled to continue my work under much more favourable conditions than before. Thanks to this valuable support, I succeeded, during the years 1881–98, in travelling over and exploring the entire island.

My first object was to acquire a pretty accurate knowledge of the interior of the island. The coast was surveyed during the first nineteen years of the nineteenth century by various Danish and Norwegian naval officers. In the years 1831–43 Björn Gunnlögsson surveyed the inhabited districts, as well as took a few trips into the interior. The map of Iceland which he drew up, in four sheets, was an excellent piece of work; but the interior of the island, which was very little known, was laid down from mere observation and the reports of shepherds and others. Indeed, of the area represented on Gunnlögsson's map, some

17,500 square miles, representing the interior, had never been subjected to scientific examination, and certain other regions (including 3500 square miles of the ice-mountains) had never been trodden by human foot.

Amongst the latter I may especially mention a portion of Odádahraun, the desert regions north-east of Fiskivötn, besides a few other places scattered up and down the island. The sources of several of the larger streams had never been seen, and the situation of some of the large groups of lakes was uncertain. My first immediate object then was to obtain a general and reliable view of the topography. At the same time there were also a number of geographical and geological questions urgently demanding solution. I intended, amongst other things, to collect materials for a geological map, on which I hoped to indicate with tolerable accuracy the extent of the several formations and species of rocks; in the next place, to attempt to trace out the broad lines of the structural history of the island; to examine and map the volcanoes and lava-streams, to study the history of the volcanic eruptions, as well as the origin, distribution, and geological relations of the warm springs, solfataras, and earth-tremors. In addition to these objects, it would also be desirable to make observations upon the modern glaciers, the altitude of their snow-line, their glacial changes and formations, the glacial scratchings, the marine deposits, marine terraces, and so forth. When I embarked upon this enterprise, I fully realized the magnitude of the task I was setting myself. I knew full well how audacious it was for a single private individual, with such limited resources as I possessed, to attempt the exploration of a country stretching over an area of 40,450 square miles, possessing an arctic climate, and being in many parts extremely difficult of access. But I took courage from the Horatian maxim—

"Est quadam prodire tenus, si non datur ultra,"

and counted upon the friendly consideration of my scientific colleagues over sea to extend to me that indulgence which is one of the brightest features of the modern scientific world. In a word, I hoped that generous allowance would be made for the difficult circumstances under which I worked. Iceland is destitute of scientific institutions and laboratories. For many years I never had opportunity to exchange a word with anyone who had an interest in geology. I am, therefore, all the more deeply grateful to those men of science in both America and Europe who have encouraged me by letters and helped me with presents of books.

Before beginning my real work of exploration, I deemed it essential to make myself familiar with the labours of my predecessors, and with all that had been written about my native island. There exist a good many books about Iceland, written in both ancient and modern times, besides a number of separate papers, scattered through Icelandic, Scandinavian, and other periodicals. These, of course, vary greatly in

value. In addition to these printed sources, there also exist in Icelandic and Danish libraries a large number of little-known manuscripts, containing a good deal of information about matters of interest relating to Icelandic geography, national life, and means of subsistence in ancient times and in modern. I have made it my duty to unearth all these sources whilst carrying on my own investigations. But seeing how vast is the material, and how widely different its constituents are in character and value, as well as how extraordinarily inaccessible a good deal of it is to ordinary inquirers, I have deemed it advisable, in the interests of future students and investigators into the geography and *kultur-historie* (social history) of Iceland, to gather them up into one collective publication,* which is now in process of being published in Icelandic and German.

I will first enumerate briefly the several exploring journeys which I made through Iceland during the period already mentioned, referring to the accounts of them published in divers periodicals.

As I have already remarked more than once, my first object was to explore the interior. Now, as the interior consists for the greater part of deserts, lava-fields, and glaciers, and as it is almost entirely destitute of vegetation, exploring trips in that direction obviously demand both time and patience,† as well as a good equipment of tents, provisions, horses, instruments, and so forth. Most of the earlier attempts to explore the most difficult parts of the interior failed from want of grass for the horses. To carry sufficient fodder to last over a prolonged stay in the high-lying desert regions is an absolute impossibility. The large expedition which was sent out in 1840, under the leadership of T. C. Schythe, in order to explore the southern part of Odádahraun, was unsuccessful from that very cause—want of grass, coupled with snowstorms. Nearly all the horses died, whilst the members of the expedition barely struggled back to the inhabited districts alive.‡ Others which followed had no better fortune. With the view of avoiding a failure from the same cause, I went to work on a plan which had not previously been attempted. I never carried hay with me from the settled districts. Scattered round the outer border of the interior plateau there are a few small oases yielding scanty supplies of grass. These are known to certain shepherds and others, who in autumn have had occasion to follow straying sheep into the desert wilds, and I got them to tell me where these spots were situated. The knowledge thus obtained proved

* 'Landfræðissaga Islands' (Reykjavik and Copenhagen, 1892–98). 'Geschichte der isländischen Geographie,' German translation by Aug. Gebhardt (Leipzig, 1897–98). Two volumes are already published. The third and last volume is not yet printed.

† "Icelandic exploration is 'chancy' as Central African, and the traveller must expect to be the sport of circumstances far beyond his control, unless, at least, he can afford unlimited time" (Richard F. Burton, 'Ultima Thule,' vol. ii. p. 325).

‡ *Kröyers Naturhistorisk Tidskrift*, iii., 1841, pp. 331–394.

extremely useful to me in my expeditions. Although frequently not greater than a few score chains square, these patches of grass served for camping-grounds, and temporary centres from which to make flying excursions to this or the other point of interest in the immediate vicinity. I used to take a scythe and rake with me, mow the grass, pack it into sacks, and in that way carry it as food for the horses whilst journeying from one oasis to another. As a rule, the desert wastes between the oases could be traversed in from two to three days. My equipment was in nearly all respects typically Icelandic, although during the first nine years, owing to lack of pecuniary means, extremely primitive and inadequate. I and my attendants lived upon the plain ordinary food of the Icelandic peasant. During our tent life in the interior we drank large quantities of coffee, but no alcoholic liquors. Surveying in the interior of Iceland is wont to be frequently interrupted by bad weather—rain, fogs, storms of sand and snow. Owing to fog, I often had to ascend the same mountain several times before I was able to get a proper observation for measurement. In fact, the principal *desiderata* for successful exploration work in the interior of Iceland are a thoroughly good equipment and an unlimited stock of patience.

In the year 1876, I took part in Prof. Johnstrup's expedition to the northern parts of the island, to study the volcanoes at Mývatn and the volcano of Askja. My own independent investigations I began five years later, in 1881, when I made a hurried journey obliquely across the island, working in with it trips to the south-west corner, where I studied the volcanoes and warm springs near Œlfus and Thingvallavatn.* I made my first long exploring journey in the summer of 1882, and with it began the execution of my plan, my former expeditions having partaken more of the nature of trial trips.† That year I went from Akureyri to Mývatn, and thence to the fjord districts of Eastern Iceland; besides which I made two or three excursions into the interior—for example, to the east side of Hofsjökull, which no traveller had previously visited. Amongst other work which I accomplished on that journey, I investigated the well-known "double spar" quarry at Reydarfjord, in the vicinity of Helgustadir, mapping it and taking drawings of it in profile.‡ But the year 1882 was for several reasons unfavourable for travel. The whole of the north coast was blocked by the Greenland drift-ice until the very end of August. The summer was so cold that

* Th. Thoroddsen, "En Udflugt i det sydvestlige Island," in *Geografisk Tidskrift*, vi. pp. 135–139.

† Th. Thoroddsen, "En Undersögelse 1882 i det östlige Island," in *Geogr. Tidskrift*, vii. pp. 95–112, 129–140. Translated into German in *Die Natur*, 34ten Jahrgang (Halle, 1885); *Petermanns Mitteilungen*, 1884, pp. 422–426; *Andvari*, ix. pp. 17–96.

‡ Th. Thoroddsen, "Nogle Bemerkninger om de islandske Findesteder for Dobbelspath," in *Geol. Fören. Förhandl.* (Stockholm), xii. pp. 247–254. German translation in *Himmel und Erde* (Berlin, 1891), iii. pp. 182–187.

very little grass grew, and some of my horses broke down. In addition to these drawbacks, the entire island was ravaged by an epidemic of measles, which carried off nearly two thousand people. Wherever I went there were sick folk, so that but little assistance was to be procured. Before the end of the journey my own men fell ill, and I was obliged to bring my summer's work to an abrupt termination.

In the summer of 1883 I explored the peninsula of Reykjanes. Although lying so near to Reykjavik, the greater portion of this remarkable volcanic peninsula had never been visited by a geologist. Except for a few fishing-stations along the coast, it is almost entirely

DR. THORODDSEN'S TENT.

buried under lava, an uninhabited and barren waste. Although it was no easy matter to use horses in that region, owing to the uneven surface of the lava and the numerous rents in the ground, I nevertheless managed to cross it backwards and forwards sufficiently to examine its remarkable geological conditions. I counted some thirty volcanoes, with over seven hundred craters of different sizes, as well as a great number of volcanic fissures, out of which the lava had flowed. I estimated that the lavas thus ejected covered an area of 730 square miles.*

The following summer I spent the time at my disposal in investigating the vast lava desert of Odádahraun and the adjacent parts of the

* "Vulkanerne paa Reykjanes i Island," in *Geol. Fören. Förhandl.* (Stockholm), vii. pp. 148–177; *Andvari*, x. pp. 1–76; *Globus*, vol. lxix.

interior plateau, ranging at altitudes of 1500 to 3000 feet above the level of the sea. The country was difficult to travel through; besides which we had to contend against a deficiency of grass, glacier streams so swollen as to be actually dangerous, and unfavourable weather. In spite of these obstacles, I was successful in ascending the greater part of the mountains, in crossing the desert backwards and forwards, both on horseback and on foot, and in covering it with a network of trigonometrical triangles drawn from mountain to mountain.* That same year I made a trip to the little island of Grimsey, lying off the north coast,† immediately above the arctic circle.

In the year 1885 I undertook no long journey, but contented myself with short geological excursions in both the north and the south of the island. But in the two following years, 1886–87, I visited the north-west peninsula of the island, and explored its many fjords. During the summer of 1886 I traversed the coast districts lying on the north side of Breidifjördr, where I found a good deal that was of geological interest —well-marked profiles of the basalt formations, deposits of lignite, petrified vegetation, as well as glacial formations and marine terraces. In August of that same year I travelled along the north-east coast of the peninsula, through the so-called Hornstrandir, as far as Cape North (the Horn). The southern portion of that coast had not been visited since the year 1754, when it was traversed by E. Olafsson; the northern portion had never been visited by any traveller. My journey along that coast was the most toilsome of any I have ever undertaken in Iceland. We had wretched weather all the time. The drift-ice had penetrated close in to the shore. The fjords and glens were shrouded in the cold fogs which generally accompany the drift-ice. All August it snowed and rained without intermission; so that we were obliged to quit the tent, and take refuge in the miserable huts of the peasantry. We used up all the provisions we had brought with us, and for several weeks had to live upon half-decayed seafowl, shark's flesh, and such like delicacies of the native inhabitants of the region. When we stumbled upon an occasional bowl of porridge, it came as a veritable feast. We got wet through every day, and had no opportunity to dry our clothes. No wonder, then, that we looked thin and wretched when we returned home.

The inhabitants of those parts of the coast dwell at vast distances apart. The mountain spurs which divide fjord from fjord are lofty, narrow, and very steep, and to climb up and down them entailed severe labour upon both horses and men. In many places the only means of getting up is along mere ribbons of footpath, that wind up the faces

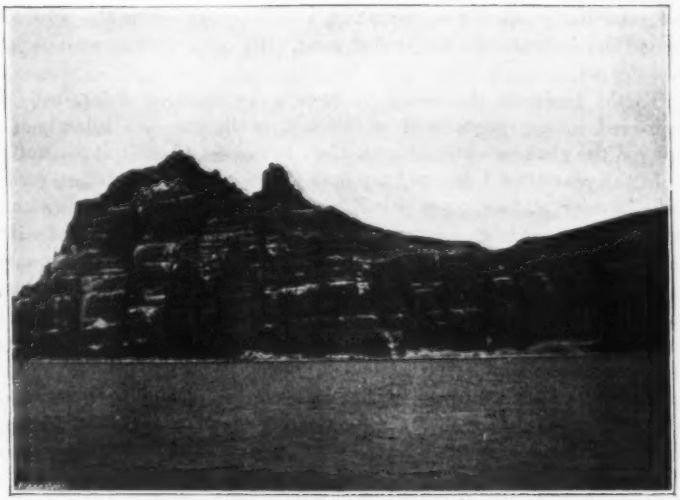
---

* "Eine Lavawüste im Innern Islands," in *Petermanns Mitteilungen*, 1885, pp. 285–294, 327–339, with map; *Globus*, vol. xlvii. pp. 183–188; *Nature*, vol. xxx. Nos. 780, 781, and vol. xxxi. No. 791. *Andvari*, xi. pp. 20–108; xii. pp. 125–161, with a map.

† *Nature*, vol. xxx. No. 770.

of the precipices, and demand the utmost caution in moving along them, whilst the surf rolls in with a thundering roar several hundred feet below. At other times the horses had to scramble over slippery blocks of stone down on the very edge of the sea, both horses and men constantly drenched by the bursting waves. At the most dangerous places we were obliged to unload the horses and carry their loads on our own backs, whilst the horses were led across one by one after us. In the valleys it rained without ceasing. On the tops of the mountains it snowed so heavily, that the snow often lay knee-deep, and the horses kept sticking fast in the snow-drifts.

The people who inhabit those tracts have a terribly hard struggle to



CAPE HORN.

live. During one-half of the year the drift-ice lies wedged up against the coast, or drifts close to it. So much of the summer's warmth is consumed in melting the ice, that it is always cold and raw during that season, and nearly always excessively damp. For this reason the people experience very great difficulty in drying the small quantity of hay they require for their few domestic animals. Their principal means of subsistence is wild-fowling, a dangerous occupation, frequently costing human lives. It would scarcely be possible to conceive anything more lonely and desolate than a cottage on the Hornstrandir. The wretched hut clings like an eyrie to the face of the steep sea-cliffs, several hundred fathoms above the water. No stranger ever shows his face within sight of it. Often the nearest neighbour lives an entire day's

journey distant. The inhabitants are almost entirely ignorant of what goes on in the world, for it is extremely seldom that an odd number of an Icelandic newspaper finds its way into those remote regions.*

I devoted the summer of 1887 to the exploration of the north-west fjords of the same peninsula. Travel on that side of the peninsula is beset with well-nigh the same difficulties as on the east side, especially towards the northern extremity, round about Adalvik, west from Cape North. In that part we were unable to take our horses, but were obliged to make our way entirely on foot. That summer those remote northern districts were suffering from famine, and a malignant form of typhus and scurvy. In the widely separated and poverty-stricken huts, where we spent the nights, there was scarcely any food to be had; and unfortunately we were not able to carry much else with us beyond the instruments we needed most. By good fortune we escaped the infection.

To the geologist that coast presents many features of interest. I discovered several deposits of *surtarbrand*, or lignite (see below), and explored the glaciers which stretch down to the sea from Drangajökull.†

In the year 1888, I directed my investigations to the southern parts of the interior plateau, more particularly the tracts around Langjökull and Hofsjökull. On that journey I was for the most part favoured with fine weather, and in the districts which I visited there were adequate supplies of grass. My first excursion was to the so-called Thjórsárdalur, where the ruins of twenty homesteads remain as melancholy witnesses of a destructive volcanic outburst in the fourteenth century. Here too there was much to interest a geologist. Thence we travelled beside the Hvítá (White river), up into the interior, where I spent several weeks, for I soon perceived that the existing maps of the districts I was visiting needed considerable revision. Whilst examining the liparite mountains of Kerlingarfjöll, I had the good fortune to discover some exceptionally fine solfataras—in fact, the finest in all Iceland.‡ I also explored the glaciers around Lake Hvítárvatn, the lava-fields of Kjalhraun, and the warm springs at Hveravellir. I made my way home by the north and west roads, and was so fortunate as to discover some hitherto unknown places with fossil plants.§

The next year, 1889, I explored the portion of the interior which was least known, namely, the tracts west of Vatnajökull, including the

* "Fra Islands nordvestlige Halvö," in *Geog. Tidskrift*, ix. pp. 31–50; *Andvari*, xii. pp. 99–203. "Eine Reise nach Nordkap in Island," in *Petermanns Mitteilungen*, 1888, pp. 113–120; *Das Ausland*, 1887, pp. 181–186.

† "Fra Vestfjordene i Island," in *Geog. Tidskrift*, ix. pp. 149–168; *Andvari*, x. pp. 46–93.

‡ 'Neue Solfatara'en und Schlammvulkane in Island," in *Das Ausland*, 1889, pp. 161–164.

§ "En Reise gjennem det indre Island i Sommeren, 1888," in *Geog. Tidskrift*, x. pp. 10–29; *Petermanns Mitteilungen*, 1892, pp. 25–31; *Andvari*, xv. pp. 56–119.

lakes which bear the name Fiskivötn. In that journey I travelled over long distances which had never before been trodden by human foot. Before visiting them, I believed that the lakes of Fiskivötn, like other similar groups in the interior of Iceland, were of glacial origin—depressions lying between ancient moraine ridges. I was, therefore, not a little surprised to discover that the greater part of them were crater lakes, and that they lay ensconced among a large cluster of volcanoes with extensive lava-fields, forming a link of connection between the volcanic regions of the south and the north of the island. To the north and east of these lakes there was nothing but deserts of sand and lava, utterly destitute of vegetation. We had to carry with us every blade of fodder we needed for the horses. I made several long excursions through those deserts, visiting, amongst other places, Lake Thorisvatn, which I found to be a little over 25 square miles in extent. In the course of another excursion I touched Vatnajökull, discovered the sources of the (river) Tungná, and also a long narrow lake, to which I gave the name of Langisjór (Long lake). On my return journey I came across some extremely interesting currents of obsidian lava.*

The exploration of the peninsula of Snæfellsnes and the districts at the head of Faxafjord claimed my attention in 1890. There was plenty of scope for geological work. I opened up several fresh fields, discovering, amongst other things, some new beds of liparite, extensive deposits of *nagelflüh*, numerous groups of craters which had never previously been examined by any geologist, warm springs, carbonic acid springs, and similar features.† The summer of the following year was occupied with short excursions to the west side of the island, more especially to the neighbourhood of Borgarfjord, where I completed certain investigations which I began in 1890; for instance, observations of warm springs and different glacial deposits and rock-striations.

In 1892 I did no exploring work in Iceland. An illness compelled me to go abroad for the summer. The rest and change, however, restored me to good health.

Next year I worked the county of Vester Skaptafell and the little-known parts of the interior plateau which fringe the south-west slopes of Vatnajökull. Travelling was anything but easy in that quarter, because of the great irregularities of surface of the lava-streams, the broken and rifted character of the mountain ridges, the want of grass, and the drift-sand. In spite of these drawbacks I was successful in penetrating to the sources of the two streams—the Skaptá and the

* "Fra Islands indre Höjland," in *Geog. Tidskrift*, xx. pp. 149–179, with a map; *Petermanns Mitteilungen*, 1892, pp. 189–196, with a map; *Andvari*, xvi. pp. 46–115.

† "Snæfellsnes i Island," in *Ymer* (Stockholm, 1890), pp. 144–188. "Geologiske Iagttagelser paa Snæfellsnes og i Omegnen af Faxebugten i Island," a supplement to *K. Svensk. Vetenskaps Akademiens Handlingar*, 1891, vol. xvii. II. No. 2, 96 pp., with map and illustrations; *Andvari*, xvii. pp. 27–118.

Hverfisfljót, which had never previously been visited. I also was the first explorer to examine the mountainous country north of Fljótshverfi. All these districts, and especially the stretch of country between the Tungná and the Skaptá, are amongst the most interesting in Iceland. I investigated the border glaciers of Mýrdalsjökull and the western side of Vatnajökull, and discovered thirteen hitherto unknown glaciers, as well as took the altitudes of the snow-line and of the edges of the glaciers in many places. But the features of greatest interest were the volcanoes. Amongst other notable discoveries I made in that quarter was a gigantic volcanic fissure (Eldgjá), which ran to a length of nearly 20 miles, with a depth of 400 to 650 feet. This fissure has in three different places ejected streams of lava, which now cover a combined area of 268 square miles. Later on in the summer I explored the chain of craters at Laki, amounting to about one hundred in number. They were the scene of a violent eruption in 1783, which left behind it a lava-stream 220 square miles in extent, and having a volume equal to a cube measuring 3 miles along each of its sides. These gigantic outflows of lava have occasioned great changes in the appearance of the country, altering the coast-line and the channels of the rivers. I made a close study of the geological development of this part of Iceland, and embodied the results in a series of maps.*

The summer of 1894 was devoted to an examination of the southern flank of Vatnajökull and that part of the plateau which borders upon the north-east side of the same glacier tract, as well as a portion of the northerly fjords on the east side of the island. For the most part the mountains in the latter region consist of basalt, but there are also a good many dykes of liparite and granophyr. I discovered close upon fifty new deposits of these eruptive rocks. At Lón I studied the gabbro mountains and their relations to other species of rocks. The only places in Iceland where gabbro occurs are the districts adjacent to the south-east corner of Vatnajökull. A great number of large glaciers radiate from the southern flank of Vatnajökull, and the narrow sandy belt of coast between the mountain and the sea is traversed by numerous rivers, conveying considerable volumes of water. I studied the physical conditions of the glaciers, and found that some of them have sensibly increased in dimensions within historic times, as well as moved nearer down to the sea. On the plateau to the north-east of Vatnajökull I investigated other glaciers, as well as discovered some new lakes and surveyed certain of the less-known districts.†

* "Reise i Vesterskaptafells Syssel paa Island i Sommeren 1893," in *Geogr. Tidskrift*, xii. pp. 167–234, with a map and illustrations; *Andvari*, xix. pp. 44–61; *Verhandl. d. Gesellsch. f. Erdkunde zu Berlin*, 1894, pp. 289–295.

† "Fra det sydöstlige Island," in *Geogr. Tidskrift*, xiii. pp. 3–37, with a map; *Andvari*, xx. pp. 1–83, xxi. pp. 1–33; *Verhandl. d. Gesellsch. f. Erdkunde zu Berlin*, 1895, pp. 185–192; *Petermanns Mitteilungen*, 1895, pp. 288–290.

In the following summer I bent my steps towards the extreme north-east of the island, the peninsulas of Melrakkaslétta and Langanes, and the portions of the plateau which lie immediately behind them. These districts had never previously been surveyed; and they revealed several features of geological importance. For instance, I ascertained that the more recent volcanic formations of Iceland extend very much further to the east than had hitherto been supposed. Here again I discovered and measured some new volcanoes and lava-streams. In the interior I found several chains of tuff hills, as well as rivers and lakes, which had never been shown on any map. Towards the end of that summer's journey I fell ill of typhus, and had to stay some time in a peasant's house. By the time I had recovered and got back my normal strength, autumn was come, and the snow and frost made it

SOLFATARAS IN KERLINGARFJÖLL.
(*After a sketch by Captain D. Braun.*)

impossible to continue my work. However, I had pretty nearly done all I had planned to do that year.*

I next directed my attention, in the summer of 1896, to the northern parts of the island, namely the mountainous peninsulas between Skjálfandi and Húnaflói, and undertook a longer excursion to Arnarfells-jökull (or Hofsjökull), in the interior, for the purpose of exploring districts there which were but little known, including the glaciers. In that quarter the plateau consists for the most part of stony deserts without a vestige of grass, so that we were obliged to carry all the hay for the horses with us.†

In the summer of 1897 I laboured in the southern lowlands of the island, in especial in those districts which were the scene of the violent seismic disturbances of the preceding autumn. My principal object was to gather details that would serve as a basis for a general view of the geology of that region, in the hope that I might thus trace out the

* "Fra det nordvestlige Island," in *Geogr. Tidskrift*, xiii. pp. 99–122, with a map; *Petermanns Mitteilungen*, 1896, pp. 269–275; *Andvari*, xxii. pp. 17–71.

† "Fra det nordlige Island," in *Geogr. Tidskrift*, xiv. pp. 7–28, with a map.

cause of the earthquake tremors, and ascertain their connection with the fundamental structure of the island, as also to collect materials for a descriptive account of the disturbance itself. Towards the close of the summer I made an excursion to the north of the island, and travelled through the *syssel* (county) of Húnavatn, studying its geology, especially its glacial deposits.* In the last summer, 1898, I explored the interior plateau north-west of Langjökull and the mountains behind the Borgarfjord.

From all this it will be seen that I have pretty well travelled over the whole of Iceland—the interior plateau, the inhabited and cultivated parts, the promontories, peninsulas, and fjords, and I have carried through my original plan of making a geographical and geological reconnaissance of the entire country. But seeing that Iceland possesses so many geological features of exceptional interest, I hope, if life is spared to me, to make further special studies of some of the more interesting regions.

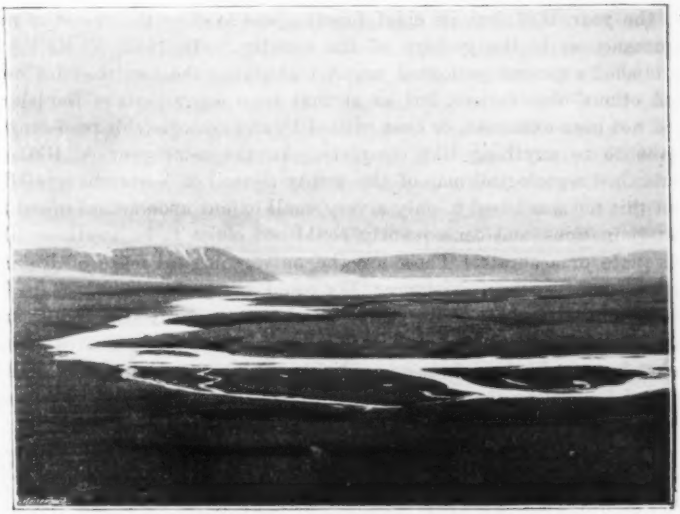
Exploration work in Iceland can only be carried on satisfactorily during the months of June to September. On the plateau you can hardly travel much before July. It is only then that the scanty supplies of grass are available; earlier than that the ground is still soft and wet, owing to the thawing of the snow-wreaths. After the middle of September the weather is as a rule rainy and stormy, at any rate in the southern districts, so that travelling becomes difficult on that account.

During the years 1880–84 I was teaching in the "modern" school (*realskole*) at Mödruvellir, near Akureyri, on the north side of the island, and one of my pupils from there, Ogmundur Sigurdsson, who has accompanied me on most of my subsequent journeys, has been of great service to me. Since the latter year I have held an appointment in the grammar school of Reykjavik. The schools in Iceland are closed for holidays from three to four months every summer; these months I employed in travelling about the island. Then by an economical arrangement and employment of my spare time between and after my daily duties (which occupied from six to seven hours) during the winter, I have found time to write the accounts of my several journeys —my books and articles on the geography and geology of Iceland. The last two years I have been allowed to engage a substitute to do my school work. Icelandic scholars have hitherto devoted their attention almost exclusively to the study of Iceland's past, her language, literature, and history. But during the last few years an interest has been awakened in the natural sciences, and some of our younger

* "Jordskjælv i Islands sydlige Lavland deres geologiske Forhold og Historie," in *Geogr. Tidskrift*, xiv., with map; *Société de Géographie de Paris—Comptes Rendus des Séances*, 1897, pp. 330–333.

students have trained themselves in those branches of knowledge at the university of Copenhagen. There is, therefore, every reason to hope that in the future native Icelanders will be able to make contributions towards a thorough knowledge of the physical conditions and phenomena of the island which has given them birth.*

As I have already remarked, one of my principal objects was to sketch a more accurate geographical picture of the plateau regions of the island, based upon surveys of the less known tracts, than we hitherto possessed. The coasts were surveyed in the early part of the nineteenth century, at which time the positions of a number of mountain summits



HVÍTÁRVATN AND HVÍTÁ.

in the vicinity of the coast were trigonometrically determined. These determinations I took as fixed points for my own surveying work. In the interior I linked the more prominent mountain peaks together by means of triangles measured with the theodolite, whilst the details between were filled in by means of the surveying compass. The maps embodying the results of my surveying operations are published in various periodicals.† Up to the present I have, unfortunately, through lack of

* With the view of awakening an interest in the natural sciences in Iceland, I wrote in my mother-tongue, 'Jardfræði' (Geology) (Reykjavik, 1889); 'Lýsing Islands' ('Description of Iceland,' translated by A. Helland) (Christiania, 1883); besides several papers in Icelandic periodicals.

† I may perhaps be permitted to add a list of the sources in which maps, based on my surveys, have up to the present been published. "Odádahraun," in *Petermanns*

time, had no opportunity to collect and publish them all together, but I hope to do so shortly.

Another important task which I set myself was to determine the heights of as many mountain peaks as possible all over the island. I have measured about eight hundred peaks, but the results in the case of only a relatively small portion of them are as yet published. I hope, however, eventually to make my measurements the groundwork of a hypsometrical map of all Iceland.

A third object was to collect materials for a general geological map of the island. The earliest geological map dealing with Iceland was the map by Paijkull, published on an exceedingly small scale (1:1,920,000) in the year 1867, but its chief function was to show the extent of our ignorance as to the geology of the country.* In 1886, K. Keilhack published a general geological map,† embodying the results of his own and others' observations, but as at that time many parts of the island had not been examined, or even visited by any geologist, his map cannot claim to be anything like complete. In the same year A. Helland published a geological map of the county (*syssel*) of Vester Skaptafell,‡ but this too was based to only a very small extent upon actual scientific determinations, and consequently could not claim to be anything like adequate or accurate. These are the only geological maps of Iceland which there were in existence. Nor could any really reliable maps be made until the whole of the island had been systematically visited and studied, and its geological structure investigated. The journeys I have taken have enabled me to issue gradually one after another some thirteen maps,§ delineating the results of my geological surveys. At the present

---

Mitteilungen, 1885, plate xiv.; "Fiskivötn and the Neighbourhood," in *Geogr. Tidskrift*, x. plate iii.; "Map of a Portion of the Interior of Iceland," in *Petermanns Mitteil.*, 1892, plate iii.; "The County of Vester Skaptafell," in *Geogr. Tidskr.*, xii. plate ii.; "South-Eastern Iceland," in *Geogr. Tidskr.*, xiii. plate i.; "North-Eastern Iceland," in *Geogr. Tidskr.*, xiii. plate iii.; "A Part of Northern Iceland," in *Geogr. Tidskr.*, xiv. plate i.

* *Svenska Vetenskaps Akademiens Handlingar*, vii. No. 1 (Stockholm, 1867).

† *Zeitschrift d. deutsch. geolog. Gesellsch.*, 1886, plate viii.

‡ *Lakis Kratere og Lavaströmme* (Kristiania, 1886).

§ My geological maps include: "South-West Iceland," in *Geolog. Fören. Förhandlingar*, vii. plate v.; "Odádahraun and Neighbourhood," in *Mitteil. d. k.-k. geogr. Gesellsch. in Wien*, 1891, plate vi.; "Snæfellsnes," in a Supplement to *Kongl. Vetenskaps Akademiens Handlingar*, vol. xvii. II. No. 2, 1891; "The County of Vester Skaptafell," in *Geogr. Tidskr.*, xii. plate ii.; "North-West Iceland," in *Geolog. Fören. Förhandl.* (Stockholm), xviii. plate i.; "A Portion of the Interior," in *Petermanns Mitteil.*, 1892, plate iii.; "South-East Iceland," in *Geogr. Tidsk.*, xiii. plate i., and *Peterm. Mitteil.*, 1895, plate xix.; "North-east Iceland," *Geogr. Tidsk.*, xiii. plate iii., and *Petermanns Mitteil.*, 1896, p. 269; "A Portion of Northern Iceland," in *Geogr. Tidsk.*, xiv. plate i.; "Geolog. Sketch-map of Landmanna-afrjettur," in *Geol. Fören. Förhandl.*, xiii. p. 614; "The Southern Lowlands," in *Geogr. Tidsk.*, xiv. plate iv.; "Direction of Glacial Striations," in *Geogr. Tidsk.*, xi. plate ii.; "Marine Terraces and Marine Deposits," in *Geogr. Tidsk.*, xi. plate vi. In addition to the above, several smaller sketch-maps of limited localities.

time I am engaged upon a map of the whole of the island, which will, I trust, be able to appear in a year or two's time, at the expense of the Carlsberg Institute of Copenhagen.

After this long trial of the reader's patience, I will now pass on to a brief description of the physical geography of Iceland. In such a short *résumé* there are of course many matters of interest which I can only touch upon in the most transitory fashion. I cannot venture to do more than state results, referring for fuller particulars to the articles and works cited under the text. I pass over my observations on the flora and fauna,* together with the inquiries I have made about the national life and the means of subsistence. The notes exist for the most part in manuscripts only; I hope to publish them on another occasion. Our knowledge of the vegetation of Iceland has been greatly increased during the last few years through the investigations of the native Icelanders, S. Stefansson and H. Jonsson, pupils of the well-known botanist, Prof. E. Warming, of Copenhagen. Indeed, the study of the geographical distribution of plant-life in the island dependencies of Denmark—Greenland, Iceland, and the Færoes—has in recent years made great advances, in consequence of Prof. Warming's energy and initiative. To him and his many gifted pupils the domain of arctic vegetation is indebted to a very considerable extent.

Iceland, which has an area of 40,450 square miles, may be broadly described as a plateau land, built up of volcanic rocks of both older and newer formation. Compared with the elevated portions of the island, the lowlands are almost a negligible quantity; they embrace only about one-fourteenth of the entire area. Nevertheless, the districts which possess most importance are the lowlands, the coasts, and the dales. With but few exceptions, they alone contain all the inhabitants of the island. All the rest, by reason of its elevation above the sea, and its climatic conditions, is almost entirely uninhabited. Along the outer borders of the plateau grass grows in summer sufficient to graze some sheep. In the interior there are only a very few patches of grass, at wide intervals apart, where a stunted vegetation grows for about two or two and a half months in the year.

The deep, wide bays of Breidifjord and Húnaflói divide the island into two separate plateaus. The isthmus, which connects the two, the north-west peninsula and the main mass of the island, is only 4½ miles across, and rises to an elevation of 750 feet.

---

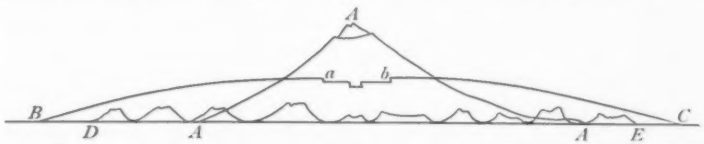
* The phanerogams, mosses, and lichens, which I have collected, are described in several papers by Prof. Chr. Grönlund, in *Botanisk Tidskrift*, and in *Meddelelser fra Naturhistorisk Förening*. (Copenhagen). Dr. Mörch has studied the fresh-water molluscs of my earlier journeys; Dr. H. J. Hansen, the insects I collected on the interior plateau.

Turning our attention first to the smaller or peninsular plateau of the north-west, we may liken its general shape to that of a deeply incised leaf. Deep, narrow fjords penetrate inwards from every direction, but in largest number from the north-west. The area of the peninsula amounts to about 3610 square miles, but the coast-line measures some 1120 miles. The fjords are shut in by dark walls of basalt, which in many places rise perpendicularly, or with a very slight inclination, straight from the sea, to an elevation of 2000 to 2500 feet. The several strata are so disposed as to form a number of steep steps or terraces, mounting up to the verge of the mountains which overtop them, though sometimes they tower upwards like black vertical walls. Their faces are beribboned with torrents, great and small, which tumble down, by waterfalls and cascades, from step to step, till they reach the fjord below. Here the geologist has a splendid opportunity to study the progress and development of the processes of erosion in the many small dales, glens, and clefts, which meet the eye in every direction. If you go up the fjords, and then ascend to the plateau through the glens, you invariably find that glen and fjord form regular constituent parts of the same deep trench cut down through the solid mass of the plateau. Once on the top, you get wide, sweeping horizons, and glens and fjords disappear from sight, or look merely like insignificant crevices. Inland, the prospect consists of a monotonous plateau, strewn with loose fragments of rock, and streaked with immense snow-wreaths. But travelling is difficult, because of the sharp-edged blocks of basalt, the pebbly detritus, and the clay, softened by the thawing of the numerous patches of snow. While the mountain-sides and the bottoms of the glens, close down next the sea, produce grass of tolerable luxuriance, together with heaths and belts of scrub, the only sign of vegetation to be seen on the plateau is an occasional Alpine plant, struggling hard for bare existence in the shelter of the larger boulders. On the highest elevations (2000 to 3000 feet) the snow drifts and consolidates into *firn* pinnacles and domes, *e.g.* Gláma, in the south-west of the peninsula; Drangajökull, in the north-east. The former of these has an area of not less than 90 square miles, but, so far as is known, possesses no glaciers. The latter, which stretches over 135 square miles, sends off seven glaciers, down as many glens, almost to the margin of the sea. On Drangajökull the climate is colder and damper than on Gláma, and the snow-line runs 800 or more feet lower, namely, at the absolute elevation of 1300 feet.

The geological data prove that this north-western peninsula was formerly larger than it is at the present time. It is, in fact, the last surviving fragment of a gigantic plateau which in Tertiary times extended right across to Greenland. This mass of basalt is built up of several faulted or dislocated segments, the faults or dislocations coinciding with the first cleavages of the larger fjords; erosion has done the rest of the work necessary to give the peninsula its existing contour and

shape.* There are no lowlands, with the exception of a narrow ribbon of strand, due to the action of the surf when the sea had a permanently higher level than it has now. But it is only on these low, narrow shelves of coast that human settlements are found. Their principal dependence is upon the sea. The people make excellent seamen, and carry on with energy, and on a relatively large scale, fishing for cod, especially in Isafjardardjup. In places where the coast strip widens out a little, and the glens produce more grass, as, for instance, along the north side of Breidifjord, the people find their chief occupation in breeding and keeping sheep. On the other hand, in places where the fjords are short, the sea-cliffs steep, and the coast-belt disappears, as it does at Hornstrandir, to the south of Cape North, the population exist almost exclusively from and upon the catching of wild-fowl.

The other and larger plateau, of which the bulk of Iceland consists, attains its highest elevation, namely 6000 to 6250 feet, towards the south-east, where the vast snowy masses of Vatnajökull cover an area of 3300



VOLCANIC TYPES IN ICELAND: A A A, TUF AND LAVA-CONE (VESUVIUS-TYPE); B C, DOME-SHAPED LAVA-CONE, WITH A TERRACED PIT-CRATER A B (KILAUEA TYPE); D E, A ROW OF SMALL CONES (FISSURE-ERUPTIONS).

square miles. The axis of maximum elevation stretches from the head of Hvammsfjord, in the north-west, to Hornafjord in the south-east. It does not, however, consist of one continuous ridge, but of a chain of snow-covered, dome-shaped mountains, separated by broad stretches of leveller ground; for instance, Langjökull, Arnarfellsjökull, Tungnafellsjökull, Vatnajökull, and others. These ice and snow-clad domes are properly so many smaller plateaus, rising some 2000 to 3000 feet above the general level of the plateau base upon which they stand, and attaining an absolute elevation of 4500 to 6250 feet. All of them are built up of tuff and breccia, and appear to have once formed integral portions of one continuous mass of tuff, which covered the middle of Iceland. The island seems to have assumed the broad contoural features which it at present exhibits long before the Glacial age, in all probability towards the close of the Miocene period.

The average mean elevation of the plateau is 2000 feet. Where it consists of basalt, it sinks at a very steep angle towards the coasts; but in those parts where the principal petrological constituents are tuff and breccia, it falls with a gentler inclination. These two species of rock

* Comp. Th. Thoroddsen, "Nogle Iagttagelser over Surtarbrandens geologiske Forhold i N.V. Island," in *Geolog. Fören. Förhandl.* (Stockholm, 1896), xviii. pp. 114–154.

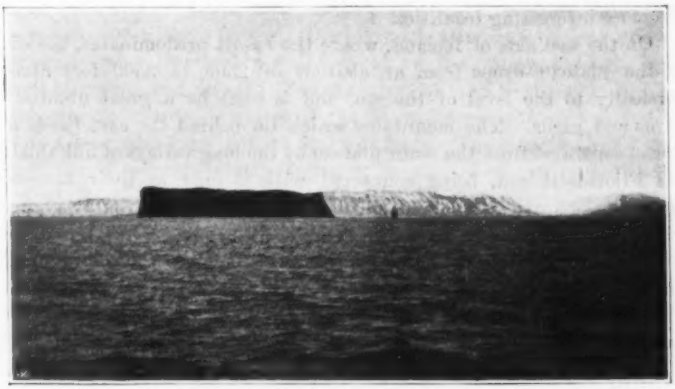
stretch across the island in a kind of belt; and it is with this belt that the modern volcanoes stand in close association. The Tertiary basalts have throughout a slight inclination from the coasts inwards to the belt of tuff, and are frequently higher next the sea than the plateau mass behind them. The interior plateau is seamed by a number of valleys, more especially towards the north and east. The spaces between the valleys are filled up with long mountain spurs, the skeletal ribs of the plateau, left behind by erosion, ramifying outwards towards the ocean. The largest tracts of level lowlands occur towards the coasts on the south-west and south of the island; although even they are crossed by a sort of promontory ridge, which projects southwards from the main plateau till it reaches the sea, and is surmounted by the vast ice-mass of Mýrdalsjökull.

As already stated, the elevated interior consists for the most part of barren deserts, but the surface varies in character in accordance with the geological constituents and formation of the underlying rocks. Where the substratum consists of basalt, or its coarser crystalline variety dolerite, the surface is strewn with a "stormy sea" of sharp-edged boulders, split and rent by frost. Where tuff and breccia form the foundation, the surface is generally covered with pebbly *débris* and fragments of scoriaceous lava, often with crusts of tachylyte. These fragments are integral elements in the breccia, and have become exposed through the action of weathering and the wind sweeping away the softer rocks in which they were embedded. But more than one-half of the interior plateau is overlain by quite recent formations, such as lava, drift-sand, ancient ground-moraines, and erratic boulders. Vast areas are simply desolate lava-fields, utterly destitute of the smallest vestige of vegetation. In fact, it would hardly be possible to conceive a drearier prospect than the boundless lava-fields in the interior of Iceland. For example, the view from the summits of Odádahraun is the weirdness of desolation itself. As far as the eye can see, the surface of the earth resembles a gigantic stiffened corpse, petrified, black as the night. The only breaks in the grim monotony are a few scattered reddish mounds of slag, brown hills of tuff, and sporadic snow-drifts. Looking southwards, you get glimpses of the glittering snow-fields of Vatnajökull; whilst towards the east the sky is obscured by the yellowish-brown aërial banks of dust, which have risen off the vast expanses of drift-sand that border upon the plateau. Nowhere a vestige of life. An oppressive silence weighs upon the entire landscape.*

Extensive areas in the interior are smothered under drift-sand,

* Mr. E. Delmar-Morgan, speaking of the lava-wastes of Askja says, "I have been in many lonely places in my life, the great pine forests of Northern Russia, the immense plains of Central Asia, the watery wastes of the Atlantic, the arid deserts of Persia, but none to equal the desolation and absolute lifelessness of that scene of Askja" (*Proc. Roy. Geog. Soc.*), 1882, p. 143.

which, when the wind is stormy, often raises serious hindrances to the progress of the traveller. You are enveloped in an impenetrable darkness, the horses become unmanageable, sand and gravel are hurled into your face with great violence, and the finer particles of dust search through every pore and opening in your clothes. The drift-sand has various origins. Examined under the microscope, the greater part of it appears to consist of nothing but minute particles of pelagonite, which has been broken off the mountain masses and weathered down through the agency of the atmosphere and the wind. Dense clouds of this fine dust, and of great extent, are frequently carried to distant quarters of the island, and there deposited in the river valleys and on the patches of grassland, thus initiating the formation of a kind of loess, which the Icelanders call *móhella*. In several valleys—for example,



DRANGEY, AN ISLAND IN SKAGAFJORD.

Land and Rangárvellir in the south—there are wide stretches covered with yellow-brown deposits of this character, held together by the roots and fibres of plants, and frequently attaining to a considerable thickness.

A good deal of the drift-sand consists, further, of volcanic ashes of recent date, in some cases mingled with glacial clay and dust, weathered to the consistency of powder. To the south-east of Askja there are immense deposits of drift-sand of a peculiar constitution, namely, crumbled and comminuted liparitic pumice, ejected from Askja during the eruptive outburst of 1875.

The exposed rocks of the interior plateau exhibit plain evidence of the power of the violent storms which sweep across it with such appalling frequency. Not only are marks of wind-abrasion and pyramidal blocks of stone common everywhere, but the general contour-lines

of the whole country show conclusive proof of the constant disintegrating action of the wind. Glacial formations are neither so prevalent nor yet so great in mass as might perhaps be expected. The larger part of the constituent materials of the moraines have been transferred into the valleys and fjords. Nevertheless, the *residua* of the ground-moraines of the Glacial epoch are pretty general in the depressions all over the plateau. In many places the erratic blocks lie heaped up by thousands together. In fact, immediately north of Hofsjökull, and in many other districts on the plateau, you could almost imagine that the *jökler* (ice-mountains) of the Glacial epoch had only quite recently melted away.

It would carry me too far to describe, at greater length and in fuller detail, the several minor subdivisions of the plateau. I must therefore content myself with a few disconnected remarks about one or two of the more interesting localities.

On the east side of Iceland, where the basalt predominates, the edge of the plateau drops from an altitude of 2500 to 3500 feet almost vertically to the level of the sea, and is cleft by a great number of fjords and glens. The mountains which lie behind the east fjords are almost separated from the main plateau by the long valleys of Jökuldalur and Fljótsdalshérad, being connected with it only at their southern extremity. Northwards from Vatnajökull the plateau falls away from the altitude of 2500 to 3000 feet at a gentle regular slope right across the island, till it reaches the coast between Langanes and Skjálfandi. Throughout that part it is principally composed of tuff and breccia and other rocks of younger volcanic origin. My geological surveys go to prove that all that portion of Iceland has subsided, there being well-marked lines of faultage going down to the bases of the mountains. At Lake Mývatn the altitude is not more than 1000 feet, and both there (Mývatnssveit) and east of Jökulsá there are several scattered farms lying at altitudes of 1250 to 1600 feet above sea-level. In the district east of Jökulsá, *e.g.* Fjallasveit, the surface consists for the most part of drift-sand. The inhabitants, who subsist principally by the breeding of sheep, feed their animals on the sandwort, or arenaria (*Elymus arenarius*), and dwarf willows (*Salix glauca*), which grow on the sand. These are the only two settled districts upon the plateau; but the extremely inclement climate renders life there anything but enviable. On the west of the stream of Skjálfandafljót the plateau suddenly shoots up again, turning a steep escarpment towards the river, and sending off northwards three broad, lofty spurs between the large fjords which there indent the coast. These ridges are built up of basalt, and in many places next the sea rise considerably higher than the plateau behind them. The highest elevations occur between Œfjord (Eyjafjord) and Skagafjord (*e.g.* Vindheimajökull, 4810 feet), and on them minor glaciers are not at all uncommon.

The mountains on the northern side of Iceland are furrowed by a great number of valleys and glens, all of which appear to owe their origin to erosion. All the same, the beginnings of these Icelandic valleys are, no doubt, of older date than the Glacial epoch. In the south-west of the island I have found that streams of doleritic lava, which themselves show glacial markings, have flowed down into the valleys; so that these must have been formed anterior to the outflows of lava. But I have nowhere found moraine *débris* or glacial striations underneath the ice-marked streams of lava; from all which the conclusion was forced upon me, that the lava was in all probability ejected anterior to the Glacial epoch. The valleys of Iceland are often very deep, being cut far down through the basalt. The *jökler* (ice-mountains) of the plateau, during the Glacial epoch, filled them up with huge moraines, which subsequently melted, leaving masses of gravelly *débris* behind; and this has since been banked up into terraces by the rivers which flow down the valleys. During and after the Glacial epoch, large lakes were dammed up in several of the valleys. Clear evidences of this exist in the Fnjóskadalur on the north side of the island, where, towards the close of the Glacial period, there was a lake 24 miles long and from 250 to 300 feet deep. The elevations of these former glacial lakes are still apparent in the beach-lines marked on many of the valley-sides. The valleys of Iceland offer exceptionally favourable opportunities for studying the forms which basalt assumes in the process of being worn down by erosion. All the various stages of disintegration exist together side by side; there are not only a great number of collateral glens, there are also many deep dells and cauldron holes (*botner*).

The western portion of the plateau, which lies north-west of Langjökull, is considerably lower than the remaining parts, the mean altitude not exceeding 1500 feet. In this quarter there are many lakes, moraine formations, and wide stretches of marsh and moor. South of Langjökull and Arnarfellsjökull the plateau consists exclusively of a barren and desolate country, especially along its eastern margin towards Vatnajökull; there lava and drift-sand reign supreme. The region lying between Tungná and Skaptá is unlike any other part of the plateau, in that it is crossed from south-west to north-east, from Mýrdalsjökull to Vatnajökull, by several parallel mountain chains of tuff, all remarkably torn and ragged in outline. The plateau east of Fljótshverfi is entirely covered by the snow and ice masses of Vatnajökull. The only exceptions are a few promontories of tuff and basalt along the outer borders of this giant among the ice-mountains of Iceland.

On each side of the wide bay of Faxaflói two ridges run out westwards from the plateau, forming the peninsula of Reykjanes on the south of the bay and Snæfellsnes on the north. Of the two Reykjanes is both broader and lower in elevation, and is built up of tuff and

breccia, as well as divided by a number of transverse faults, disposed in a south-west to north-east direction, into several step-like minor plateaus, which decrease in altitude from east to west. These fissures have been the "springs" of immense lava-streams, which now overlie the greater part of the peninsula. Of larger volcanoes there are but few; on the other hand, there are several "strings" of craters of no great elevation.* The ridge which constitutes the backbone of Snæfellsnes is both higher and steeper, but at the same time narrower, than that which traverses Reykjanes. At the extreme end of the peninsula there is a large ancient volcano, Snæfellsjökull (4710 feet), capped with glaciers. There has been no eruption during historic times, although the surrounding country exhibits abundant evidences of both ancient and modern outflows of lava. Some of the lavas have been scratched by the passage of ice over them, proving that the volcano was active prior to the Glacial epoch. All along the ridge there are craters from which lava has issued and flowed down upon the lower-lying tracts, as well as alkaline and carbonic acid springs.†

(*To be continued.*)

A TRIP ON THE THA-ANNE RIVER, HUDSON BAY.‡

By the Rev. J. LOFTHOUSE.

On July 7, 1896, I left Churchill in a small Peterborough canoe, accompanied by two Chipewyan Indians, to explore the "Tha-anne" and Fish rivers, which empty themselves into Hudson bay about 100 miles north of Churchill. These rivers had never before been traversed by white men, and one of them, the Tha-anne, was but little known even to the Indians. The ice had cleared off early from the coast (I have been fast in ice on August 1), and I felt sure we should have no difficulty in reaching the "Tha-anne." The day was beautifully fine, and quite calm; but the mosquitoes were in myriads, and very fierce.

We paddled across Button bay on to North river, when, a fair wind springing up, we hoisted our sail and stood right across the Seal river bight, a terrible place for canoeing around the coast, as the tide runs out so very far, at times leaving one high and dry out of sight of land. We camped that night about 10 miles south of Long point, which we reached early next morning. This point is really a sand-ridge about 100 feet high, and forms the western side of the Churchill bight as Cape Churchill forms the eastern, each point being about 40 miles from the mouth of the river. After rounding the point, we were met

* "Vulkanerne paa Reykjanes i Island," in *Geolog. Fören. Forhandl.* (Stockholm), iii. pp. 148–177.

† 'Geologiske Iakttagelser paa Snæfellsnes og i Omegen of Faxebugten i Island' (Stockholm, 1891), 98 pp.

‡ Map, p. 336.

by a strong head wind, and obliged to camp down in the inlet, where we were dreadfully tormented by mosquitoes.

Next day we passed Egg island (just a stony reef a few feet above high-water mark, and where hundreds of eider ducks come to breed, hence its name), and made our way down the inlet towards the Tha-anne. Here we were caught by a severe thunderstorm, and were in danger of being swamped, but were rewarded by the most magnificent rainbow, the like of which I never saw before. There were seven distinct bows, all most clearly defined, and touching the horizon, whilst all within was black as the darkest night. We were obliged to spend the night on a point of land where neither water nor wood was to be found.

Early next morning we pressed on, after replenishing our larder by two fat deer which we shot, and late that evening got to the mouth of the "Tha-anne," where we spent the night. The shore here is very low and flat, and at low water nothing is to be seen but miles of mud flats with large boulders standing up on every hand. A more dangerous place for a boat coming in under a strong breeze could not be met anywhere, and with a gale from sea it would mean certain destruction, for one could not miss the stones. Next morning we got into the main channel, but only at high tide could even a small boat get up it. It is hard to define the mouth of the river, the banks being so low. On a small island we gathered about 300 eider duck's eggs; though rather far gone, my Indians seemed greatly to enjoy them. During the day we made our way up the river, past the Fish river, which empties into the Tha-anne about 10 miles from the coast. Here the banks, composed of sand and gravel, rise some 12 feet. Not a tree was to be seen, and going up the river we saw not the slightest sign of any driftwood, so we had to depend on the moss for boiling our tea-kettle. About 5 miles above the Fish river we came to the first rapid. Here the river is hemmed in between two rocks, about 30 yards apart, and we had to make a portage of some 300 yards. The rocks are sandstone and granite, and just seem to crop out here, running almost due north. For some 3 miles above this rapid there is a good stretch of water, and then we come to a series of heavy rapids, stretching some 10 or 15 miles. Over the greater part of these we had to portage everything. There is a very heavy rush of water, up or down, which even a boat could not pass. The ground here rises to some 50 feet, and is composed of sand-dunes, whilst away from the river seems one vast mossy plain with no sign of wood at all.

At the head of these rapids we came to the first lake, about 12 miles wide. Crossing this in a westerly direction, we found the channel, up which we went against a very strong current, but no rapids. Here we came upon the first signs of trees, small stunted willows; but they were very pleasant to see after the barren country from the coast, and we

were glad to get a fire. Next day we made our way mostly up heavy rapids, where the ice was still piled high on the banks, and we had difficulty in getting past some of it.

After another hard day's work in the rapids, we got into the lake district, where the Fish and Tha-anne rivers divide. Here the land rises to the height of some 200 feet, and the country is one network of lakes, with a few stunted pines here and there, but as a rule bare, bleak, and barren as possible. On Sunday, July 19, after working round the north shore of a small lake, and up a short but very rapid river, we came into a long narrow lake about 15 miles east and west. Thence by a narrow channel we passed into "Thao-lintoa," or Pipestone lake. This is fully 20 miles from east to west, and about half that from north to south. After crossing this, we got into the upper Tha-anne, where we found a very swift current, but no rapids. Here the banks are high on both sides, just sand-ridges with no sign of rock. Up this we worked for two days. The north side was all barren land, whilst away to the south were a few stunted pine woods. The river takes a very sudden turn to the east, and a short swift rapid of about a mile took us into Tha-anne lake. This lake is fully 60 miles long, but very narrow in the centre, with bare, bleak hills on the north; but on the west and south-west there seems to be a little timber. The upper end of the lake was packed with ice, and we had to portage across a narrow neck of land to avoid it. We struck away to the north-west, where we hoped to meet with either Indians or Eskimo. We found some old tents, but no signs of life. The country is as bleak and desolate as one could well imagine, with no signs of wood anywhere. A small river here enters the lake, and my Indians said we were within about three days of the Kazan river and Tath-kyed lake.

On July 23 we turned our faces homeward, and in a few hours, with a strong fair wind, crossed the largest reach of the lake. All the ice had drifted away south, and soon we entered the upper Tha-anne river. Down this we ran at a great rate, and in thirteen hours covered what had taken four days in going up. On Saturday, July 25, leaving the Tha-anne river at Sucho-lintoa lake, we crossed by a series of short portages into the Fish river. This is a much better river to navigate than the Tha-anne, and until we got to within 20 miles of the coast we only made one short portage. After that the river divides into two channels, and the water becomes very shallow. We took the northern one, and ran down at a great rate, often with only a few inches of water under our canoe. I quite expected we should come to grief, and was really glad when we entered the Tha-anne, where we had plenty of water. We reached the coast at the mouth of the Tha-anne in just half the time it had taken us to go up, and after a good run along the coast, reached Churchill in safety on our twenty-fifth day out.

The country through which we passed is a very wild and dreary

one, and can never be of much use except for hunting. There seems to be hardly any signs of minerals, though the Eskimo and Indians both say there are quantities of "mica" away to the north-east of Thao-lintoa lake. The timber is very scanty, and there seems to be hardly any on the north side of the Tha-anne river. All the rock seems to be granitic sandstone, and crops out here and there, all running down to the coast, where it comes out about 50 miles south of Marble island.

TASMAN'S LIFE AND VOYAGES—REVIEW.*

By EDWARD HEAWOOD, M.A.

In view of the important services to geographical discovery rendered by the great Dutch navigator Tasman, it is at first sight surprising that so long a time should have been allowed to elapse before the publication of a complete critical account of his life and labours. For two centuries after his death the published material was restricted to brief abstracts of the chief events of the voyages, and not until 1854–60 was the journal of the most important voyage—that of 1642–43, which resulted in the discovery of Tasmania and New Zealand—made generally accessible by the version of Jacob Swart in the *Verhandelingen en Berigten betrekkelijk het Zeewesen*, which, however, has since proved in many ways inaccurate. This paucity of published material is explained by the fact that most of the documents by which light could be thrown on the subject remained buried in the Dutch Colonial Archives, which have been systematically examined only within the last half-century. During that time material has been steadily accumulating, thanks to the labours of Dutch scholars; but the results have not hitherto been known as they deserve to be in other countries. Particularly welcome, therefore, is the recent publication, by the well-known firm of F. Muller of Amsterdam, under the editorship of Prof. J. E. Heeres, of a facsimile reproduction of Tasman's original journal, with all its maps and drawings, accompanied by an English translation, and a critical account by the editor of the navigator's life and labours—the whole forming a folio volume of over four hundred pages. Although we believe that other scholars—Mr. Coote in this country, and Prince Roland Bonaparte in France—have been for some time working at the same subject, it is in every way fitting that the first satisfactory account of the great navigator's work should have been prepared by one of his countrymen, who, from his former position as Conservator of Colonial Archives at the Hague, is thoroughly qualified for the task he has undertaken.

As the reproduction of Tasman's journal forms the *raison d'être* of

* 'Abel Janszoon Tasman's Journal of his Discovery of Van Diemen's Land and New Zealand in 1642, with Documents relating to his Exploration of Australia in 1644.' Edited by J. E. Heeres. Amsterdam: F. Muller & Co. 1898.

the whole volume, it will be well first to follow the editor in his account of the manuscript, and comparison with other sources of information on the voyages, which forms the eleventh section of his memoir. The manuscript in question is the only original copy, signed by Tasman himself, which is known to exist at the present time. Its history cannot be traced back for any length of time, and Prof. Heeres merely states that it was in 1867 presented to the Hague State Archives by Mr. J. G. Gleichman, who obtained it from the papers left by Mr. F. A. van Hall. He shows reason, however, for regarding it as the identical copy of which the text was printed by Swart, and which was then in the possession of the firm of Hulst van Keulen, with which he was connected. It is, Prof. Heeres thinks, not the original diary, but a narrative prepared under Tasman's direction from the ship's journal, and afterwards signed by him. The numerous sketches of coasts, groups of natives, etc., appear to be by another hand, probably more of an expert in such matters. Of any other original copies which may have existed, there remains now only a single folio leaf, which bears evidence of having belonged to the copy used by Valentijn. There exists, however, in the Hague Archives a draft-journal, probably by a sailor of inferior rank, and of little interest except for purposes of comparison, and as giving one or two additional details. A copy of Tasman's journal in possession of Mr. J. E. Huydecoper van Maarseveen (used by Lauts for his biography of Tasman) appears to be a careless transcript, and thus of inferior value, though, like the last, supplying some additional facts. One more copy is in existence — that in the British Museum, formerly owned by Sir J. Banks—a translation of which was used by Burney. This, according to Prof. Heeres, seems to be a transcript of the copy now reproduced.

The original matter relating to the 1644 voyage is, as all commentators have lamented, of the most meagre description, and almost the only trustworthy source of information is the map, drawn up after his return under the eye of Tasman himself, and showing the tracks followed in both the Australian voyages, with the soundings taken during the second. A rough copy of this was published by Swart, and, failing access to the original, now in the possession of Prince Roland Bonaparte, the present publishers have been able only to supply a copy based on Swart's, but with corrections founded on contemporary documents. Mr. Coote ('Remarkable Maps of the 15th, 16th, and 17th Centuries,' part ii.) assumed that the original map must have been drawn up by F. J. Visscher, pilot-major in the expeditions, but Prof. Heeres thinks it quite as probably Tasman's own work. The British Museum chart, of which a copy was given by Major ('Early Voyages to Terra Australis'), was not, he considers, copied from the Bonaparte chart, as the discrepancies are too numerous, but probably from a lost chart of Visscher's, used by Tasman in the preparation of his own. After mentioning some of the

earliest published maps in which the results of Tasman's voyages were shown, Prof. Heeres vindicates his countrymen from the reproach of leaving to foreigners the promulgation of the new discoveries. Although the colonial authorities were doubtless far from zealous for the publication of new information, that this secretiveness was not very seriously meant is proved, in his opinion, by the public panegyric of the poet Constantijn Huygens, soon after the opening of the new Amsterdam town hall (1655). This poem referred in terms of praise to the hemispheres represented on the floor of that building, in which Tasman's discoveries were set forth.

Some interesting details are also given respecting the earliest published accounts of Tasman's voyages. The first of these, based on the original journal, appeared in the exceedingly rare work of Van Nierop * (1674), whence it was translated into various languages. Prof. Heeres refers to the English version of 1711, but not to the earlier edition published by Dr. Hook in his 'Philosophical Collections' in 1682. Curiously enough, this English version was retranslated into French (although Thévenot had already issued an adaptation in that language), and appeared in one form or another in various French collections. Valentijn's account (used by Dalrymple) and that of Burney have already been alluded to.

Some account must now be given of the other sections of Prof. Heeres' memoir, which summarizes in a useful form all that we know of Tasman and his work, with abundant references to authorities. Some long-standing misconceptions are cleared away, and many details not generally known are given, with various information regarding the Dutch operations and policy in the far East. The erroneous idea, originated though subsequently abandoned by Lauts, that Tasman's birthplace was the town of Hoorn (the sponsor of Cape Horn), has been reproduced in some recent publications. The honour is now known to belong to the village of Lutjegast. New evidence is supplied regarding Tasman's second marriage (in 1632), while a detailed account is given of his early career in the East, of which but little has hitherto been known. It is an interesting fact that the first voyage (1634) in which Tasman took part as commander of a vessel was one of discovery, resulting in the opening of the route north of Ceram, by which the dangers of the more southerly route during the Eastern monsoon were avoided. In 1839, after a visit to Europe, he took part in a more important exploring voyage, being associated with Quast in the search, in the seas east of Japan, for the mysterious islands "Rica de Oro" and "Rica de Plata," supposed to be the richest countries in the world. The origin

* Misprinted "Van Merop" in Rainaud, 'Le Continent Austral.' This author is often spoken of by English writers as Dirk Rembrantz, the full name being Direk Rembrantsz Van Nierop.

of the rumours then current respecting these islands is traced by Prof. Heeres, who also gives a fairly full account of the voyage. Quast's journal, discovered in 1842 by von Siebold, has never been published, but in the present work all such passages are printed as refer to the discovery of land or the touching at islands, etc.; while the valuable chart, drawn up under Tasman's supervision, is reproduced, supplying a clear view of the peregrinations of the voyagers through the watery wastes of the north-western Pacific. Although the voyage was, by force of circumstances, barren of important discoveries, it was by no means devoid of practical results, for the observations of the captains—excellent considering the instruments then in use—introduced important corrections into the maps, even in the case of known countries.

Other sections of the memoir deal with Tasman's part in the Dutch trading enterprises in Formosa, Japan, and Camboja, and various missions to Sumatra, Siam, and elsewhere. An important chapter is devoted to a discussion of the knowledge of Australia possessed by the Dutch before 1642, though the author does not attempt to solve the problem of the actual first discovery of that continent. If, he says, to other nations the darkness had been dissipated to any degree worth mentioning, nothing beyond the merest glimmer had reached the Dutch of that time, to whom, therefore, belongs the full credit of opening the way to wider knowledge. He protests against the unsupported statements of Mr. Collingridge, as to the appropriation by the Dutch of the discoveries of others. The review of the voyages previous to 1642 shows clearly the systematic plan adopted by the Dutch authorities, and the aims of the expedition of that year. Prof. Heeres sketches briefly the work performed both by this and the subsequent expedition, giving also some interesting details respecting the pilot-major Visscher already alluded to. With regard to the voyage of 1644, he is able, unfortunately, to add little to the scanty details already available, and it can only be hoped that some fortunate investigator may some day light upon the journal, known once to exist. It is matter for congratulation that such trustworthy material should be at hand on the subject of the former voyage, which after all was far the more important, as showing the way for the first time across the trackless expanse of the Southern Indian ocean.

In conclusion, reference must be made to the interesting chapter by Dr. Van Bemmelen (with map), on the variation of the compass in those regions in Tasman's time. Its interest lies in the fact that the variation was found by that navigator to be *nil* in the longitude of the southern point of Tasmania.

ITINERARY FROM KANTARA TO EL ARÍSH.*

By A. R. GUEST.

From *Kantara* to *Juja* (13 miles, small well, bad water); *Bír en-Nisf* (6 miles, permanent well, bad water); *Katia*, *Bír el-Hajjaj* (9 miles, a stone-built well, water good, watering-trough); *Bír Abu Husun* (6 miles, well); *Bír el-Affein* (6 miles, well); *Bír el-Abd* (5 miles, well, very good water). About 6 miles from Bír el-Abd, the road enters a salt plain called *Seil el-Khaishum*, from a bluff at its west end; the name *Sibakh Bardawil* on some maps was not heard. The effects of mirage were a line of surf running in on a low beach. *Ras Beni Nizal* (12 miles); *Lakhwarat* (14 miles, well, very brackish water); *Saiyat* (2 miles, a small

WELL AT KATIA.

mound); *Bardawil* † (3 miles), the place where the intestines of "Robert the Devil," one of the first crusaders, were buried, when he died on his return from Egypt. There are here certain holes or marks in the ground, and it is the custom

* This is an abstract of an itinerary made during two journeys to El Arísh by Mr. A. R. Guest, of the Ministry of the Interior, Cairo, and Mr. A. McKillop, of the Ministry of Finance; the journeys were made in May and September, 1898. The map is from Jacotin's large French map, the coast from the Admiralty Survey, palm groves, etc., are from the tracing sent by Mr. Guest.

† Bardawil, or "Robert the Devil," is Baldwin II., King of Jerusalem, who died near El Arísh.

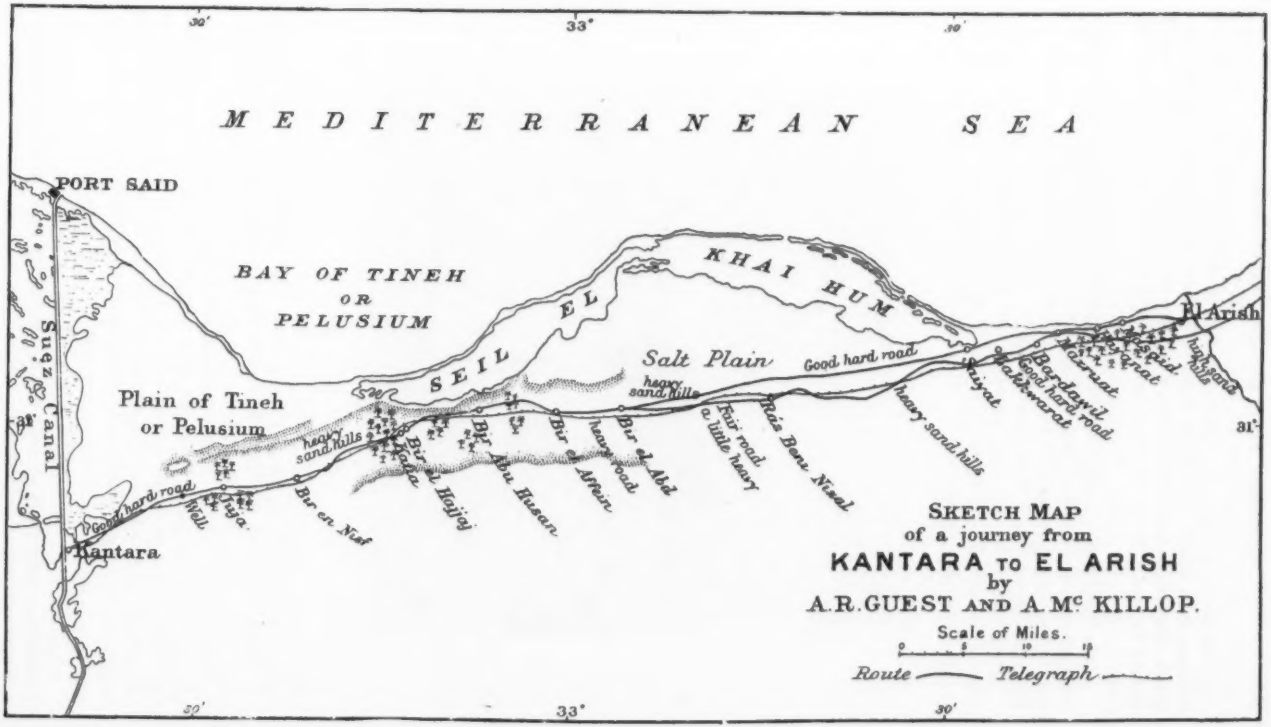
of every one passing to kick the sand out of them. *Mazruat* (2 miles). Between Lakhwarat and Mazruat there are stones at regular intervals (1 or 1½ kilometres) along the road, which are said to be measures of distance. *Hayanat* (3 miles); *Masaid* (2 miles, well of good water from which El Arish derives its supply: *El Arish* (4 miles).

The road from Kantara to Juja is good and hard; thence to 5 miles from Katia, it is bad, among heavy sand-dunes, which are apparently moving. The road is fair through Katia to Bir Abu Husum; it then becomes very heavy as far as the salt plain, after which it is good, and in part excellent, to El Arish. There is a line of telegraph to El Arish. Excepting between Juja and Katia, there is excellent food for camels along the road.

El Arish lies among sandhills about 1½ mile from the sea. It is 24 miles from

SIGNALLING-TOWER (KATIA).

the Syro-Egyptian boundary, and 92 miles by the coast to Port Said. The population is about 4000. The houses are flat-roofed, and built to withstand the rain, which is considerable in winter. On rising ground to the west of the town there is a large stone fort, built by Sultan Suleiman (the Magnificent), and within it a black stone covered with hieroglyphs, which is used as a drinking-trough. East (? west on map) of the town is a large palm grove containing 10,000 to 12,000 trees, which extends to the coast; and to the north are large numbers of fig trees, only watered by rain; vegetables are grown, and the water-melons are famous. Landing from the sea is only possible in very fine weather, but it is always practicable in a cove a mile or two to the north. There are several wells of brackish water: good water is obtained from Masaid, about 4 miles to the west. In May nearly all the men, women, and children go to Syria for the harvest. The sand is moving towards the town from the north-east, and it is now within a


30'
33°
30'
MEDITERRANEAN SEA
PORT SAID
BAY OF TINEH
OR
PELUSIUM
SEIL EL KHAI HUM
Suez Canal
Salt Plain
Good hard road
El Arish
Plain of Tineh
or Pelusium
heavy sand hills
Bir el Abd
Fair road
a little heavy
Ras Bens Nesal
heavy sand hills
Good hard road
Kantara
Bir en Nisf
Bir Abu Husan
Bir el Affein
heavy road
31'
SKETCH MAP
of a journey from
KANTARA TO EL ARISH
by
A.R.GUEST AND A.Mc KILLOP.
Scale of Miles.
0 5 10 15
Route
Telegraph
30'
33°
30'

couple of feet of the parapet of the north wall of the fort. According to native tradition, there was no sand at El Aríah at the time of the Turkish conquest (A.D. 1520). The site of the ancient town, which lay to the north-west, is now deeply covered by sand. Water is said to come down the Wadi El Aríah once every two years.

Katia is, apparently, on an old site, as the remains of a town and of a signalling-tower are visible near Bír el-Hajjaj. There are six wells, and about 2000 camels, and 2000 sheep and goats. The governor of the old town, who was sometimes an Emir, is often mentioned in Memluk history.

There are 33,000 palm trees, owned by 960 proprietors who belong to sixteen different tribes.* The trees are in groups in valleys, and each valley, called a *haud* (or *hauz*), has its own name. In an area of 2500 square miles there are 252

GRAVE OF "BARDAWIL."

hauds in which dates are grown. There is no other cultivation. Each *haud* has one or two wells, with sides lined with palm leaves. Eighty-three per cent. of the trees are *Hiami*, the fibre of which is of no use, and only two per cent. are of the best quality (*Bint Aisha*). During the date harvest, which lasts from the beginning of September to the end of November, there are about 10,000 women and children living under the trees to collect the harvest. The principal market is Port Said, the next is Gaza, where most of the compressed dates (*'Ajwat*) are sold. The trees are increasing in number and yield. This appears to be partly due to the fact that

* The tribes are: es-Sadaín, el-Bili, el-Mázah, el-Masaíd, el-Hatim, el-Katárna, el-Akhárisat, el-Bayádiyin, el-Aríah, et-Tameilát, en-Nafiaát, el-Abáyidat, es-Samáana, Aulád Ali, el-Akáibat, es-Sawárikat.

the people know that they have only the Government tax of 2½ P.T. to pay, and have no taxes to pay to local notables.

The trees, when taken from the parent tree, are planted sufficiently deep in the ground to be near water, and are covered about halfway up the branches. They

EL ARÍSH.

are left thus for four years, and then, on each successive year, a hole is dug at one of the sides and filled with sheep and camel manure. Very few of the trees are irrigated. The people consider the land beneath the trees their own property, and when they sell the trees the land goes with them. They sell by private deed, and in a few cases register the deeds; but as a rule they sell by word of mouth.

ON THE SUB-OCEANIC PHYSICAL FEATURES OFF THE COAST OF WESTERN EUROPE, INCLUDING FRANCE, SPAIN, AND PORTUGAL.*

By Prof. EDWARD HULL, LL.D., F.R.S., F.G.S.

It has been recognized that the British Isles and adjoining parts of the European continent rise from a submarine platform, generally known as "the 100-fathom platform," or "shelf," and that this terminates seawards along a more or less steep slope, or escarpment, descending to the floor of the abyssal regions of the ocean at depths varying from 1200 to 1500 fathoms. But it has not been so generally

* Abstract of paper read at the Royal Geographical Society, January 27, 1899.

recognized that the continental platform is traversed by ancient river valleys and cañons, connected with—or inferentially traceable to—the rivers which drain the adjoining lands, and which, deepening their channels, ultimately open out on the floor of the ocean at the foot of the escarpment. These sub-oceanic river channels, if laid dry, would show a very close resemblance to the cañons of Western America, which, it is well known, originate in mountainous regions and traverse extensive tablelands between lofty walls of rock, and open out on the plains at "the base-level of erosion" in each case—a term invented by American geographers.

1. Submerged Physical Features.

Having on a former occasion described the sub-oceanic features off the coasts of the British Isles (*Jour. Victoria Institute*, vol. xxx. p. 305), the author does not propose to reiterate the facts and conclusions there stated, further than to observe that similar physical phenomena are to be discovered by means of soundings all along the continental shores to the south of the British Isles, only more pronounced and conclusive than even in the former region. Throughout this whole region, extending from the shores of Iceland by Rockall, then southwards by the Western Hebrides, the coasts of Scotland, Ireland, and England, round the Bay of Biscay, and southwards along the coast of Portugal to the Straits of Gibraltar, we find the following features:—

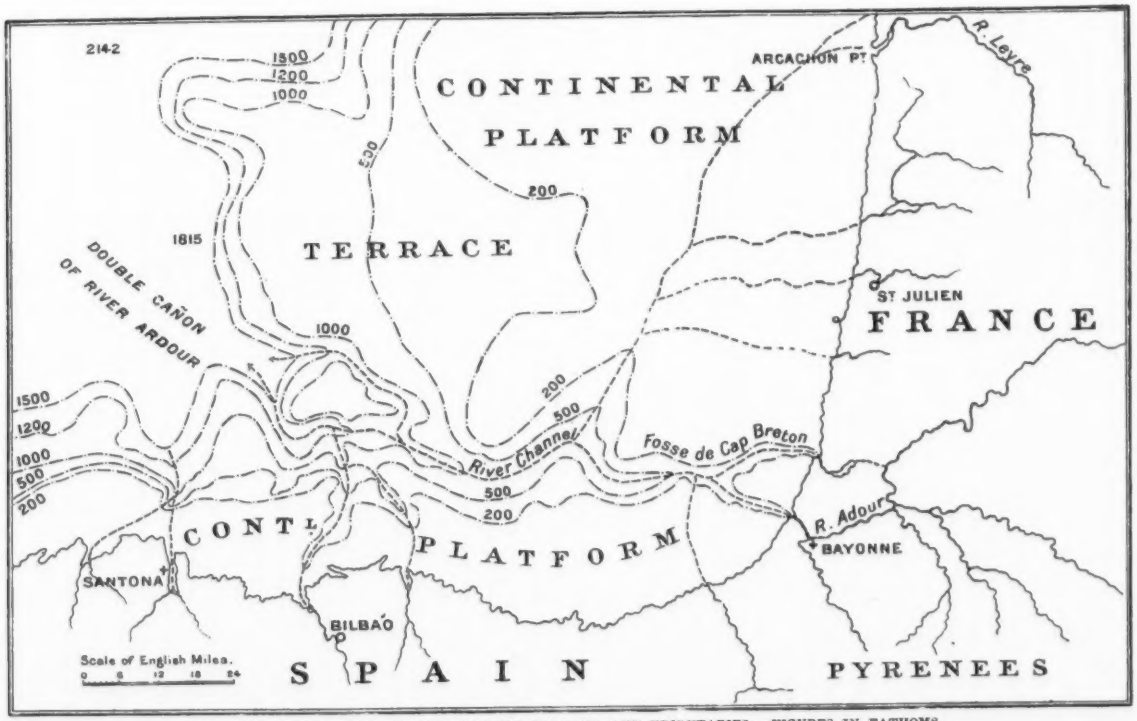
A. *British and Continental Platform.*—A gently shelving platform stretching seawards to varying distances from 20 to 200 miles, terminating in a declivity or escarpment at depths (according to distance from land) varying from 100 to 200 fathoms.

B. *The Grand Escarpment.**—A continuous bank or declivity descending from the edge of the platform, of varying steepness, and at its base forming the margin of the abyssal ocean. The slope of the Escarpment varies in places from 5° to 36°.

C. *River Channels and Cañons.*—Numerous submerged river valleys traversing the continental platform, sometimes bounded by precipitous walls of rock over 1000 feet in height, and receiving tributaries on either hand. The cross-sections, drawn to scale from the Admiralty soundings, at intervals of several miles, show these channels to be true river valleys, as they are characterized—(1) by a continuous deepening of the bed of the channel in the direction of the outlet; (2) continuous widening of the channel in the same direction; (3) a winding course, altogether unlike that of faults or fissures of the strata; and (4) lateral branches descending on either hand from the adjoining lands—tributaries of the period. The phenomena are such as characterize river valleys, either those containing running streams, or now dry, as in sub-tropical districts. One additional characteristic, however, still remains to be stated; namely, continuity with the channels of existing rivers, as in the cases of the Adour and the Tagus. While the channels of these two important rivers can be traced almost continuously out into the ocean from the mouths of the existing streams, several others can only be inferentially connected, the intervening part of the channels connecting with the present river having in these cases been filled up by silt, sand, and gravel. The following submerged river channels have been determined by the author by means of the soundings and isobathic contours drawn on the Admiralty charts by the aid of the soundings themselves:—

---

* The word is here used in the popular, not the strictly geological, sense. We are, of course, absolutely ignorant of the structure or composition of the rocks of which the escarpment is formed.



THE RIVER ADOUR, WITH ITS SUB-OCEANIC CHANNEL AND TRIBUTARIES. FIGURES IN FATHOMS.

2. Sub-Oceanic River Channels.

Channels off the British Isles.—(1) The river Erne, (2) the Shannon, (3) the Irish Channel river, (4) the English Channel river *—the latter for a distance of 70 miles, occupying the channel shown on the Admiralty chart as the "Hurd Deep."

Channels off the Coast of France.—(1) The Loire, (2) the Gironde, and (3) the Adour, of which the submerged channel, for a distance of 5 or 6 miles from the mouth of the existing river, is marked on the Admiralty chart as "La Fosse de Cap Breton," but has been traced by the author for a further distance of about 50 miles, to the position where it opens out on the floor of the abyssal ocean by means of a double channel at a depth of 1500 fathoms (or 9000 feet), and at the base of the Grand Escarpment (see Map, p. 287).

Channels off the Coast of Spain and Portugal.—(1) The Caneira; (2) the Arosa; (3) the Lima; (4) the Douro; (5) The Carvoeiro, one of whose sides just off Burling island shows a sheer descent of about 5000 feet; and (6) the Tagus, also characterized by a double outlet. The waters of this great river appear to have entered the outer ocean in a series of grand cascades, with a total descent of 5000 feet within a distance of 6 or 7 miles.

The above are the principal river channels determined by means of the soundings, and indicating stupendous changes of level of the land; as it is only by the agency of sub-aërial river-erosion that channels such as those above referred to could have been formed. Their counterparts are now to be found in Colorado and other parts of Western America, but on a still more stupendous scale.

3. Isolated Rocks and Sea-stacks.

Amongst the physical features and objects by which the line of the grand escarpment was diversified, the most conspicuous were probably the isolated rock-masses and sea-stacks, which we are enabled to trace by means of the soundings. One of these cases may be specially mentioned. The mass rises at a distance of about 36 miles off Cape Razo, in the submerged valley of the Tagus; it is an isolated sea-stack, with a height of 2340 feet from its base. Its analogues, but on a diminutive scale, are to be found in the isolated masses of Rockall, Ailsa Craig, and the Bass rock; and, like them, it may be conjectured that it is formed of some very hard igneous or volcanic rock.

4. Conclusions.

In conclusion, it is pointed out that the Grand Escarpment forms the physical line of separation between the abyssal region of the "*globigerina* ooze" † and of the platform covered by silt, sand, and gravel with shells of recent species, amongst which Colonel Godwin-Austen discovered dead littoral shells far out to sea, and at depths of 80 to 100 fathoms—relics of former marginal conditions.

The author also maintained that the phenomena described can only be satisfactorily explained by supposing the ocean bed ‡ to have stood at a level of several thousand feet above that of the present day, during which the sub-oceanic channels were eroded by river-action, while the Grand Escarpment was being cut back by wave-action, during a long-continued pause, succeeded by general depression of the whole region. The phenomena here detailed, and the conclusions arrived at, are in harmony with those described by Prof. J. W. Spencer, Mr. Warren

---

* These two, 3 and 4, had previously been traced by Prof. Boyd Dawkins and Mr. Jukes-Browne, but not exactly as determined by the author.

† Dr. C. C. Wallich, 'The North Atlantic Sea-beds.' 1860.

‡ Of course, including the adjoining lands.

Upham, and others on the western side of the Atlantic ocean; and reasons were adduced for believing that these changes of level had taken place in late Tertiary and Post-Tertiary times.

Sir Archibald Geikie: I have listened with considerable interest to this paper, which deals with that borderland between geology and geography where the two sciences harmoniously unite, and where their followers are apt to do battle. Prof. Hull has laid before us material enough for a good deal of battling. Apart from his conclusions, from which we may widely dissent, I think the method that he has followed is a sound one, namely, to try to map out the contours of the submarine floor by means of soundings. There can be no doubt that the floor of the sea is a region that undergoes practically little change. Save in its upper and landward portions, the sea exercises a conservative influence on the Earth's surface. The contours which have been carried down by subsidence below the sea-level, or such as have been produced by subterranean forces under the sea, have probably remained unchanged for ages, except for the slow deposit of organic or inorganic sediment upon them. The task does not appear hopeless to restore the features of any wide terrestrial surface which has been submerged under the ocean, and it can only be accomplished by some such method as that followed by Prof. Hull. But the following out of the method, by giving wide scope to the imagination, may lead to great diversity of opinions. I suppose, if three members of the company were to sit down at the same Admiralty Charts that Prof. Hull has used, we should have three totally different views with regard to the configuration with which he has dealt. It would be necessary to use the soundings with the utmost caution, and plot the profile-sections on a true scale. I am not prepared to say how far I could agree with the author in regarding the depressions which he has traced on the Atlantic floor as submerged river-valleys. If we should be convinced that the depressions have really had the origin which he assigns to them, it would be impossible to contemplate such charts as he has brought before us without being convinced that the process of erosion which he invokes must go far back beyond the Pliocene period to which he has referred. We hardly realize the vast antiquity of many river-valleys. I have little doubt that some of the rivers of Scotland were flowing in Tertiary time, and that the excavation of their glens goes back as far as that remote period. While the land has suffered enormously in the long lapse of ages, the portion of the Earth's surface that is covered by the sea has remained practically unaffected. Only by such a method of restoration as Prof. Hull has followed, in which we must be constantly on our guard against giving a loose rein to our fancy, shall we ever be able to find out much about the history of submerged lands.

Mr. Hudleston: I can say with Sir Archibald Geikie that we are very much indebted to Prof. Hull for having brought forward a subject of this sort, which is one in which both geography and geology have so much in common. Myself and the author likewise have had an opportunity for renewing an old controversy. The one great feature which we have to realize is what Prof. Hull calls the "grand escarpment," portions of which you perceive on the map of the Bay of Biscay, and which extends on the eastern side of the Atlantic basin up to the north-west of Spitsbergen. He is pleased to call it an "escarpment," and the feature is certainly one of the grandest on the Earth's surface—a feature which has been revealed to us by geographers, and whose origin it is the business of geologists to attempt to explain. There is no proof that this feature is of the nature of an "escarpment" in the sense understood by geologists. I contend that the proper term for it is "the sub-oceanic continental slope"—a name applied by Prof. Milne at a meeting

of this Society a year or two ago, when he gave some very interesting details respecting it.

Any one who wishes to understand this sort of controversy should endeavour to realize the difference between the "submarine platform" and the "sub-oceanic continental slope." The submarine platform, generally known with reference to the British Isles as the area within the 100-fathom line, has at one time been an old land surface, and there is no reason to doubt that there have been old river courses, though the actual tracing of such rivers may be open to criticism. An elevation of 600 feet would, in most cases, more than suffice to bring this platform within the reach of meteoric agencies. But there is a vast difference between this platform and the sub-oceanic continental slope which leads down to the great oceanic abyss; the phenomena applicable to the one are not necessarily applicable to the other. Hence I very much doubt whether the phenomena described by Prof. Hull, such as grand cañons, etc., are really due to meteoric agencies; yet it must be admitted that there are some very curious features in the slope, though possibly there may be other interpretations than that of meteoric erosion. It would be interesting to hear what geographers have to say upon this point, and more especially those whose business it is to make charts.

If we accept Prof. Hull's explanation, what does that imply? No less than an elevation of 6000 feet for the whole of the English Channel area. What evidence is there that any portion of this part of Europe was raised 6000 feet during a period so recent as the Pliocene? It would be more reasonable to include the whole of the Tertiary period for the formation of his "grand cañons," though this is greatly open to doubt. Some geologists have been rather too prone to construct maps of the several periods such as they conceive to be true, and they have had no objection to make the crust of the Earth bob up and down just as it suited them. If we were to accept the theory of permanence, within certain limits, of the principal features of the Earth's surface, these amusements would be interfered with very much. In conclusion, I would observe that it is more philosophical to accept the existing phenomena, as we know them on the Earth's surface, for our guide in studying the history of the past, rather than predicate these great movements which possibly had no existence except in the imagination.

Dr. W. T. Blanford: I agree with nearly all Sir Archibald Geikie's and Mr. Hudleston's remarks, but I am not prepared to admit the absolute permanency of oceans. The subject Prof. Hull has brought forward is of very great importance. The whole question depends upon whether the soundings that Prof. Hull has laid before us afford sufficient evidence of what he terms cañons. I wish we could get rid of this Spanish word; there is a good English word, ravine, which means the same thing. In the first place, I think the soundings are rather scattered, and that the deeper parts of the sea are connected together on imperfect evidence. In the case where probably the best evidence is available, that of the English Channel, Prof. Hull has remarked that the Hurd deep appears to be isolated—that is to say, that, although in one place a depression is known to occur, it is not possible to connect that depression with the notch in the continental slope, which is supposed to indicate a gorge cut by a river. As to whether the Hurd deep has been kept open through the greater swiftness of the tidal currents in that part of the channel, I must say that I feel very great doubt, because where the tidal current is strongest, there would be the greatest tendency to movement of the fine sand and silt, especially of that which is dragged along the bottom, and where this takes place I should think the depths would be silted up more rapidly. Then as regards the distribution of the different channels, it is noteworthy, as Prof. Hull has very rightly pointed out, that it is difficult to connect some of them with any stream

and they do not appear to be developed in proportion to the importance of the stream. Of that very curious deep channel of the Adour there is clear evidence, yet the Adour is a comparatively trivial stream; in the case of the Loire, a much greater river, the evidence is far weaker. I should like to ask whether Prof. Hull can find any evidence whether the greatest stream of Western Europe, the Rhine, cuts a channel in the continental slope.

It would be a good test of the whole question to examine whether the Rhine, after receiving the Elbe and the drainage of Eastern Great Britain, did cut such a channel. There is a minor point to which I may as well call attention; the stacks or isolated rocks rising from considerable depths. There is one, to which special reference has been made, off the north coast of Spain, but I think that Prof. Hull has misunderstood the evidence in this case. As far as I can find—I have just looked at the chart—it is founded upon a sounding of 250 fathoms. I think Prof. Hull has overlooked the line and dot above the number, signifying that no bottom was found. It is quite possible that some other errors may have arisen from the same cause. I most heartily concur with what has fallen from both Mr. Hudleston and Sir A. Geikie as to the improbability of so enormous a change in relative elevation as would be caused by the raising of the whole of Western Europe 6000 feet in Pleistocene times. And it is at that very same time that we are assured by many geologists that there was a depression of, I think, something over 2000 feet, of which evidence is found on the mountains of Wales. It cannot be supposed that there was both a depression of some 2000 feet and also an elevation of 6000 feet, and it is still more startling if the elevation in Europe is supposed to have been contemporaneous with the elevation of which we are told on the coast of North America, so that the whole area of the globe covered by the North Atlantic ocean and its shores was raised to this extent. If this took place there must have been a corresponding depression in some other part of the world, and surely some evidence of this should be forthcoming. On the other hand, I ought not to conclude without saying that I think there is sufficient *primâ facie* evidence to render it possible that the correct explanation is that which Prof. Hull has put forward, but we ought to have further evidence before we can accept it.

Admiral Sir WILLIAM WHARTON: I have listened with a very great deal of interest to Prof. Hull's paper, but, at the same time, with a feeling of regret that I had not been able to see his former paper on the subject, and to examine the details. As I think Archibald Geikie said, the whole or a great many of Prof. Hull's points depend upon whether there is sufficient evidence or not for the different features he has drawn. I must confess that without having had the advantage of examining the charts, I cannot venture to criticize them in detail. But he mentioned in his abstract that there was a very well-marked channel off the mouth of the Tagus, and I spent ten minutes this afternoon looking at the chart, and I am bound to say that the evidence that is there in the shape of soundings is insufficient to say whether there is a channel or not. I found many, many square miles without a single sounding, and, what is more, I happen to be aware that the soundings off the mouth of the Tagus are particularly suspicious. They were taken at a very early stage, so that I do not think very much reliance can be placed in a channel unless there is more evidence than there is in that case. There can be no doubt whatever—I am not a geologist; I speak as a hydrographer—that we have in various parts of the world now under water, relics of what must have been very well-marked channels. But all those have been well defined. Trouble has been taken and careful soundings made, and we can depend upon the contours; but when the soundings are taken in the middle of the Bay of Biscay by different ships at different times and by different people, and when you think how small the scale of a chart is, and

that you cannot trace any more than the broadest features upon it, I think you cannot find anything that can be called evidence of small features, or of such narrow channels as are drawn on the chart.

Mr. VAUGHAN CORNISH said that he had spent an hour and a half before the meeting in examining the soundings along and in the neighbourhood of the blue lines of supposed river courses traced on the charts which Prof. Hull exhibited in illustration of his paper, and he found in those soundings no justification for the river courses shown. Prof. Hull had suggested that the remarkable trough called the Hurd deep really continued further up channel, but was there filled up by a thick deposit of sediments. He (Mr. Cornish) wished to draw attention to the fact that in Delesse's map there was shown here a broad band of rocky bottom stretching across the English Channel. The evidence brought before them that afternoon was wholly insufficient to establish a claim to have traced the sub-oceanic river-channels off the west coasts of the British Isles, France, Spain, and Portugal.

Dr. GREGORY: Prof. Hull's theory has the attractiveness of simplicity, but it involves the very improbable assumption of a 9000-feet elevation off the coast, whereas there is no proof of such elevation on the adjoining shores. This improbability renders necessary a careful consideration of the alternative theories of the formation of these submerged "cañons." There is no doubt that some of these channels are submerged river-channels, but in many cases the explanation is doubtful. Thus Marcel Bertrand has explained the "Hurd deep" as a line of subsidence by folding, and that suggestion must be refuted before we can accept the Hurd deep as a river-channel. Another theory explains these channels as "cañons" of deposition instead of "cañons of erosion." For instance, there is a "cañon" off the mouth of the Congo, which Buchanan attributes to materials brought down by the river being deposited on either side of the mouth. In some cases these "cañons" occur where it is quite impossible that they could have been formed by subsidence; *e.g.* at the eastern end of Lake Geneva, where the Rhone flows into the lake, there is a "cañon" which cannot have been formed by erosion. Are Prof. Hull's channels genuine "cañons," or are they to be explained by the other theories? In the case of the Hurd deep, there is the evidence that it is probably a line of warping. In regard to the "Irish Channel river," there is no single depression such as Prof. Hull's diagram suggests, but a series of elongated banks formed by the action of currents. There is a similar case off the Humber, which is instructive, since, as the tidal current there is at right angles to the course of the river, so is the "cañon." The paper would have been more convincing had it given a monographic treatment of one or two cases, instead of a general survey of a wide field. The existence of some submerged river-channels is probable, but as there are alternative theories explaining the facts, every case has to be judged on its merits.

[As several speakers attached weight to the Adour "cañon," it may be added that there are reasons for regarding that as a line of subsidence, on which movements are still taking place.]

Professor HULL in reply said: I am afraid, if I am to reply to all the speakers, I should have to go over my case again, which I do not intend to do. Sir Archibald Geikie, with his usual caution, which is very admirable for one occupying his position, has given a sort of preliminary acceptance to the views. He has not raised any serious objection against them, except as regards the enormous lapse of time. I must reply, as I did before, that that question of time is one that grows upon one as they become older geologists. When you recollect that the middle Tertiary strata have been raised up during that period to thousands of feet in the

Alps, it shows that the Earth is quite capable of performing such revolutions as I have ventured to suggest. Now, I do not really quarrel with Mr. Hudleston because he prefers calling the descent from the platform into the abyssal region a continental slope rather than an escarpment; but I would like to know how he can possibly tell that the rocks on the margin of that escarpment may not be strata in some places which will answer very well to an escarpment such as that of the Cotteswold hills; and I think, until we have some more knowledge of what this platform is composed of, we need not quarrel about its designation. I am quite as much at liberty to call it an escarpment (using the term in a general sense) as another geologist is to call it a continental slope. Prof. J. W. Spencer has also said, in the *Geological Magazine* for January, that such a slope as that I have described is generally recognized as "an escarpment" in America. It is really a matter of names, and I do not think it is worth while holding any controversy upon it. Then he says, "What evidence is there that Western Europe was raised 6000 feet?" and he calls the idea unphilosophical. That is a matter of opinion. But I will endeavour to give the evidence as concisely as possible. (1) There is a community of fauna and flora between Iceland and North-Western Europe; but in order to effect a land communication between the two countries the bed of the ocean must have been elevated *at least* 550 fathoms (or 2750 feet), probably much more. (2) Certain species of plants in the west of Ireland are evidence to a former land connection with Spain and the south of Europe—as long ago pointed out by Prof. Edward Forbes. (3) The former existence of glaciers in the Atlas mountains and the British Isles, together with a vast extension of those of the Alps, Pyrenees, and Scandinavia. A colder climate would be the direct result of elevation in these regions. (4) The fact as shown by the soundings of the late Captain Spratt, that the Mediterranean region had been partially elevated into land, so as to connect Africa with Europe through Malta and Sicily (*q. J.G.S.* vol. xxiii.), and the general migration of the Pliocene animals into Africa by that means, as shown by Dr. Wallace. Thus we have cumulative evidence in favour of great elevation of the land in addition to that shown by the soundings. Mr. Blanford, for whose views I have the greatest respect, doubts the efficacy of the current in keeping the channel of the Hurd deep open. Well, I need not labour that question again. I know there are others who agree with me; it seems to me that the currents there are so strong as quite to answer the purpose of keeping that channel clear. And then about the Rhine. I hope to undertake the examination of the charts to the east of the British Isles and the Baltic after I have completed this work that I have at present in hand. Well, then Mr. Blanford asked how it is possible that the depression which took place in the glacial period, of not 2000 feet, as he states, but 1200 feet, in North Wales, as evidenced by the existence of beds of gravel with shells—how it could have taken place during the period when, as he supposes, I was holding that it was a period of great elevation. My answer to that is this: that this depression, which I certainly hold took place all over the British Isles during the middle glacial stage, was a different epoch to that of the great elevation shown by these observations. We first had an enormous elevation, and then a depression extending to a depth of 1200 feet at a later epoch. Then Sir William Wharton throws some doubt upon the soundings; but I am not responsible for the soundings. I take the soundings as I find them on the Admiralty Chart, and I presume they are correct. If he thinks they are not correct, then I am afraid the responsibility lies on his shoulders. Mr. Vaughan Cornish's criticism is what I may call destructive criticism. Any one knows how easy it is, in working out a subject of this kind—I don't like to say to pick holes—to find little objections to special points, and it is impossible for me at this moment

to verify his statements. I do not pretend that my channels are all absolutely perfect, that they are not incapable of being modified and improved, but I have drawn them to the best of my ability. I think the best way for any person who doubts them is to get the Admiralty Charts, to adopt the plan that I have adopted, and draw the isobathic lines for himself, and then he will have better ground for disputing them. Dr. Gregory's views of improbability have no weight with me at all. Questions of probability or otherwise in natural science subjects are matters which I cannot possibly recognize. As for the Congo and the cañon of deposition, I think that is a very questionable argument indeed. I understand this sub-oceanic channel of the Congo is of enormous depth, and it is quite impossible to admit that it could have been formed by the heaping up of materials on each side. Why should the materials be heaped up on each side? Once a river goes into the ocean, the current very soon ceases, and the waters become subject to the currents which move around it, the tendency of which is to spread the materials and to fill up hollows rather than allow of their being piled up on each side, as described by Dr. Gregory. I think, sir, that is all that is necessary for me to say in reply.

The PRESIDENT: I think the chief point on which Prof. Hull finds disagreement with those who have joined in the discussion, is with regard to the question of geological time, which is not a geographical question at all. But most of the gentlemen who have discussed the paper were agreed that Prof. Hull's method of ascertaining the contours and the shape of the ocean bed by means of the examination of soundings, is a correct one, and any of the points in which he is mistaken were probably consequent on the want of materials. No doubt, if he continues his investigations in some points he will be confirmed, and in others perhaps he will not be confirmed, in his present views. He has merely formed his opinions on the actual material that was before him, on the charts, and he has certainly given us a most interesting paper. I am sure you will all join in a very cordial vote of thanks to Prof. Hull and to those who have joined in the very interesting and important discussion which followed.

FORMER TRADING CENTRES OF THE PERSIAN GULF.

By Captain A. W. STIFFE, R.I.M.

V. KUNG.

THIS is now only a large fishing village, chiefly of mat huts, extending about half a mile along the low sandy shore, and containing perhaps 2000 inhabitants. It stands on the Persian coast about 3½ miles north-eastward of Linga. There is a large date grove and much cultivation at the back of the place. The fishermen, as usual on this coast, are of Arab descent, the cultivators Persian. There is a fair anchorage, sheltered from the prevailing winds, but open to the "saheili," or south-wester, which is of rare occurrence, but occasionally blows with considerable force. The beach is shelving, and landing for boats bad in consequence, except at high water. There are extensive mounds and ruins of the old town of two to three hundred years ago, and remains of large hummums. The walls of the old Portuguese factory, a large white ruined building, still stood at the time of our visit, but in a very tottering condition. It was a commodious square building of several stories. Opposite to it stands a round fort of good masonry, which is surrounded by the sea at high water; it is circular in form, not above 20 yards across, and has several embrasures for guns, and some vaulted casemates or chambers underneath. There is a large excavation near the factory, which, we were

informed by the people, had been a dock—a sort of mud dock, I presume. There is little produced here, except a common kind of pottery, there being good pottery clay near.* At one time, it was told us, very superior pottery was made here.

The land slopes gently up from the shore to a height of several hundred feet, and presents, as in so many places in these parts, a geologically recent calcareous crust, largely composed of shelly *débris*, overlying thick beds of clay, which formation leads to very broken ground being formed by the washing away of the clay. This sloping ground ends abruptly in little cliffs a few miles inland, beyond which is an extensive plain of clay, barren, and level. At the back of the rising ground, 5 or 6 miles to north-westward of the place, rises a detached hill, an outlier of the same formation, to a height of 600 feet. It has precipitous sides. There is a narrow difficult path up to the top, which is covered with ruins, and many water-cisterns to catch rain-water—more than a hundred, we are told—of the usual description; they are oblong excavations in the ground, cemented inside, and have arched roofs to prevent evaporation, which have mostly fallen in, and choked the cisterns. They are common all along the coast at the present day. The ruins were mere mounds, and no inscriptions could be found. The path up has been fortified, and walls built along the edge of the cliffs where at all practicable. Nothing seems to be known of its origin. It is now called Kaleh-Lestán.

History.

Kung is not a place of great antiquity, and it appears to have risen to importance only after the expulsion of the Portuguese from Hormúz, when they established a settlement here, and it appears to have become their headquarters, and a place of some trade.

In 1652, Tavernier† went from Basra to Congo (Kung), where, he says, there is a "Portugais" factor, who receives half the customs; he also mentions that the road from Lar (the capital of the province) to Congo is bad by reason of want of water and craggy, narrow ways.

Between 1693 and 1699,‡ Dr. Gemelli Carreri travelled from Shiráz to Lar and Congo; he also complains of the horrible roads, passed over the "rude montagne" of Chiampa, which has on the summit the "Karvansera de Serkou" (Sár-i-kuh, *i.e.* summit of mountain), two miles from which they sighted the Persian gulf and Bander Congo descent, environed by precipices into the plain, where were several small hills of different colours. At Congo, Joseph Pereira d'Azevedo was superintendent of the royal Portuguese agency; they lodged at the convent of the Augustins. The Portuguese received an annual tribute of five horses and 1100 tománs (about £500), by a convention made after the Persians had taken Ormus, because the Portuguese troubled with their vessels the navigation of the whole gulf, which lessened the customs (of Persia); and, besides, they had the great

* We were told a curious story about this pottery, which is not incredible in that country. The artisan who improved the manufacture was doing well for himself and getting known, when an order came down from Teheran to the local governor, that he was to be sent up to the capital, where he was appointed to be maker of china to the Shah. The man feared that if he went to Teheran he would have to make pottery for every one connected with the court, and never receive any pay, so he took all the money he had made to the governor, and implored him to report that the man who made the good pottery was gone, no one knew where. After which he never made any more good pottery.

† 'Collection of Travels of Tavernier,' etc. London, 1684.

‡ 'Voyage autour du monde,' Traduit de l'Italien de Gemelli Carreri. Paris, 1727.

privilege of having a house, hoisting their flag, and jurisdiction over all Christians landing. At first they received half the customs, but, owing to disputes, it was compounded for the above annual payment. The narrative says the superintendent gives passes to Mohammedans for safe navigation of the Indian seas, and sells the prizes taken by Portuguese vessels. Bander Congo, which is open to the sea, is in lat. 27° (really 26° 35′). "Nearly all the houses are of mud; only some near the sea are of stone. It is a dependence of Lar, under a deroga and chabander (shahbandar, customs officer). It is a country of great trade, vessels continually arriving from India, Basra, Arabia Felix, and other places, besides caravans without number. The chief trade is in pearls, fished up in the isle of Baharen and all the gulf; they are bought cheap, wholesale from the fishers,* and sold dear in retail." He then describes the little copper sieves, still used, for sorting the different sizes, and the separation of the round and white from the misshapen and stained or of less clear water; also the skilful boring by the Arabs, "so that one can scarcely see the hole;" also he refers to the method of bargaining with the hands under a cloth, which is still practised. He mentions the unhealthiness and great heat, "so that even the birds hide themselves in the trees;" the people go nearly naked, the rich clothed with "very fine stuff." He mentions the wind-towers on the houses, and says Bander Abassi is still hotter; and also describes the guinea-worm absolutely exactly, with the practice of winding it slowly out of the flesh. "The roadstead is defended by a fort, 30 'palms' square, and armed with four iron cannon, made by order of D. Constantine de Norogna" † (Noronha?) when he was viceroy for the King of Spain. Water was only obtainable from cisterns, as at the present day, on this coast.

He saw vessels of the Portuguese, of sixty and seventy guns, lying off Congo, and says, "I know only the English and Dutch go to Gomroon (Bandar Abbas); all other nations traffic at Congo, on account of the security given by the power and maritime force of the Portuguese. There are about 10,000 inhabitants—Moors, Indians, Arabs, Jews, and Armenians, who have fine shops." He gives a good description of the pearl fishery, and the submarine springs at Bahrein.

He also describes the "ship"-building, and says, "Instead of nails, which they are without, they use 'chevilles' (pegs) of bamboo or cane, and further join the planks with 'ficelles' (strings) made of rushes (probably coir or coconut fibre). For anchor, they have a large stone with a hole, and for oars, a stout stick with a little round plank attached to the end." All this is unchanged at the present day for the coasting boats. He attended mass and visited the bazar, being astonished at the men "who put burning coal in their mouths like cherries, by the aid of the demon," so he was told. During the Diváli (the great Hindu holiday), the "Banianes" (the Hindu merchants) had a "Nautch," which he describes at length, and "which pleased him so much that he wanted to see them again and again." He also visited Kalah Lestán (see *ante*). He sailed for India in a "Moorish" ship, as the Portuguese were at war with the Maskat Arabs, and had a long passage, being driven back from Pasni (on the Makrán coast) to near Jashk, "owing to the incredible ignorance of the pilot, who was sailing by chance, never having had any other business than tobacco-seller." The captain had recourse to our traveller, who seems to have taken charge, and "on the 16th we found

* This is now chiefly done at Linga, a large town, the successor of Kung, nearly 4 miles to the south-westward.

† From Danvers' book, 'The Portuguese in India,' it appears Constantin de Noronha was Captain-General of Ceylon in 1629. Don Miguel de Noronha was viceroy 1629 to 1635.

ourselves at the same place as eleven days before—delay to which those are exposed who embark in Moorish vessels" (he philosophically remarks).

As to the date of the occupation of Kung, the Chevalier Chardin,* between 1671 and 1677, visited "Congue." He says that in 1625 the Portuguese surrendered Bahrein to Persia, and other small islands, "on contract to get half the customs of Congue." He says they got tribute from even the smallest boats, and permitted no trade with India except in their own ships. After the fall of Hormuz (1622), the Portuguese retired to Maskat, and then followed the treaty about Kung. They gave passports to native ships under very stringent conditions and limitations. M. de Thevenot† visited Kung in 1665. He left Basra in the ship of an Armenian of 260 tons, 18 guns, and 31 seamen—the captain, gunner, and two sailors being the only "Franks." She was furnished with three passports, Portuguese, English, and Dutch. "The captain was a good sailor, but knew not how to set off a course, nor take an observation, nor read or write." The quarrels of the ignorant skipper with the Arab pilot are given at length, and "indeed, it was commonly the Shiraz wine or Congo brandy that raised all this huff and din." He says, "Congo has a little castle defended by three pieces of cannon." Sulphur was exported. Water had to be brought from a distance. "The custom-house receives a great deal of money, especially within these last two years, on account of the extortions of the governor of Bender Abbassi. One-half the profits belongs to the King of Portugal, who, after the loss of Ormus, still so infested the King of Persia by his ships, that continually kept cruising along that coast, that Persia was constrained to make peace with him upon conditions. The King of Portugal keeps an agent there, who flies the Portuguese flag. The Dutch used to send a factor to buy pearls there from Bahrein." He stayed sixteen days at Kung.

His description of dealing with water-spouts seems worth quoting. "Besides the devotions of the Holy Gospel, the human remedies which seamen use against water-spouts is to furl all the sails, and to fire some guns with shot against the pipe of the spout. If that succeed not"—he describes a curious superstition of "cutting it with a black-handled knife, without which they never go on board for that reason." This latter is probably from hearsay.

I have not been able to trace an account of the date of the abandonment of Kung, or of the reasons for it. Captain Hamilton,‡ 1688–1723, says the Portuguese *lately* had a factory at Kong.

THE GERMAN DEEP-SEA EXPEDITION.§

FURTHER news of the voyage of scientific investigation in the *Valdivia* has reached us in a letter from Prof. Chun, the leader of the expedition, to Sir John Murray, dated January 20, 1899. The voyage down the Atlantic to the edge of the antarctic ice, and thence through the Indian ocean, has been most successful, the soundings alone serving to fill an important gap on the charts, and showing that the average depth of the Southern ocean must be considerably greater than has been supposed. Sir John Murray considers that the success of the German investigators

* 'Voyages du Ch. Chardin en Perse,' etc. 2 vols. 4to. 1735.

† 'The Travels of M. de Thevenot,' etc. London, 1687. Newly done out of French.

‡ New Account of the East Indies, etc., 1727.

§ Chart, p. 336.

in attaining so high a southerly latitude in a vessel not protected for ice-navigation is very remarkable, and that it augurs well for the prospects of a scientific antarctic expedition. Prof. Chun's letter is as follows:—

"In sending you the accompanying sketch of our route, I need only remark that we penetrated much further into the antarctic regions than we originally considered possible. We were only 100 nautical miles distant from Enderby Land, and in that position dredged in 4647 metres (2541 fathoms), bringing up a great number of stones which are not of volcanic origin.

BOUVET ISLAND

"I caused our course to be directed towards Bouvet island after leaving the Cape, and we were happy to be able to find this island, which has so often been sought for in vain. It was no small achievement for Captain Krech to accomplish this, impeded as he was by storms and dense clouds, and surrounded by icebergs. Bouvet island lies in lat. 54° 26′ S. and long. 3° 24′ E.* This island is entirely buried in glacier-ice, and is steep and inaccessible. It appears to consist of a volcanic cone, with a broad crater-edge; we found basalt and tuff in the dredge.

"From Bouvet island we sailed along the edge of the ice-pack for 50° of longitude, with mostly calm weather. I was particularly surprised by the immense depth of the sea; many of the soundings exceeded 3000 fathoms. The sea is, at any rate, much deeper than has been hitherto supposed. From Enderby Land as far as Kerguelen we encountered heavy storms; finer weather commenced at St. Paul.

"I hope soon to be able to send you a full report dealing specially with the serial temperature observations and the chemical analyses which have been made. We have to regret the loss of our surgeon, Dr. Bachmann, who died in the Indian ocean; otherwise all the members of the expedition are well, and join with Captain Krech in heartiest greetings."

* This longitude is occupied on the Admiralty charts by Lindsay island, but it appears doubtful whether Bouvet, Lindsay, and Thompson islands, shown near each other in the chart, all exist.—Ed. *G. J.*

THE MONTHLY RECORD.

EUROPE.

The Etymology of London.—In last year's volume of the *Tour du Monde* (*A travers le Monde*, p. 307) M. E. Maison calls attention to a suggested explanation of the origin of the name London, given in 1864 in a pamphlet by M. Féret, printed at Dieppe. The suggestion was based on the statement of Cæsar, that the maritime parts of Britain were peopled by invaders from Belgium, who gave to their settlements the names of their native places; and on the existence in the Dieppe district of the three townships, Lime, Douvrend, Londinières, the similarity of whose names to the three chief places reached by invaders of England is certainly striking. Against this idea, however, must be set the peculiar applicability of the name London, derived from Celtic words signifying "pool-fort," or fort over the lagoons, to the site of the place at the time of the Roman invasion.

The Physical Features of the North German Plain.—There is perhaps no part of Europe, to the physical features of which so much attention has of late been paid, from the point of view of their origin, as the North German plain. Since the general acceptance of the idea that the present surface features are due to the former existence of a vast ice-sheet over the country, many points have been explained which before were quite enigmatical. Two papers have lately appeared in which the present physical geography is explained by reference to the past—the one by Dr. K. Keilhack (*Geographische Zeitschrift*, vol. iv. part 9), dealing with the surface features in general; the other by P. Herden (*Deutsche Rundschau*, vol. xxi. part 2), treating only of the river systems. Dr. Keilhack explains that as there seem to have been three distinct ice-ages, the second of which saw the furthest advance of the ice-sheet, the effects of the first cannot be expected to be still visible, nor those of the second, except where its ice-sheet advanced beyond that of the third, viz. on the southern margin of the district, and to the west of the Elbe. Beginning with the deposits due to the ice-sheet, he distinguishes between moraines and material laid down by the glacial streams. The first division of the former—ground-moraines—take various forms, from nearly level plains to drumlins and irregularly undulating country, with no level spaces, such as the Baltic lake plateau. The second division—end-moraines—are most prominent along the southern margin of the Baltic ridge, where they form a remarkable and unbroken rampart. Of forms due to the ice-water, we have first the ridges and furrows formed beneath the ice-sheet, often in a direction at right angles to its margin; to this class belong the regular lines of hillocks and ridges known as "Åsar." The effect of the glacial streams outside the ice-sheet is of course greatest in the neighbourhood of the end-moraines, deposited where the ice remained a long time stationary, or oscillated within narrow limits. Here they cover vast areas with gravelly or sandy deposits, the equivalents of the "Sandr" of Iceland. In discussing the deposits formed at a distance from the ice-sheet, Dr. Keilhack enters into the question of the ancient drainage system of Northern Germany, thus covering the same ground as Herr Herden, but keeping in view rather the forms of surface resulting from the action of the streams than the development of their present courses. He differs from the latter writer in considering that the great longitudinal valleys which traversed Germany from west to east, or from south-west to north-east, existed in their broad outlines before the ice-age, being deepened by the advancing ice, according to a well-recognized law, and afterwards utilized by the ice-stream. Herr Herden, on the other hand, lays down that they are post-glacial, due to the vast streams of glacial water which found their way to the North sea.

along the margin of the ice at its various stages of retreat. Both writers give, broadly speaking, the same account of their courses, which coincided with the westward-flowing sections of the modern rivers, the main outlets being first along the line of the Aller and lower Weser, and afterwards along that of the lower Elbe. The paper in the *Rundschau* is accompanied by a map showing the supposed courses of these great glacial streams. Dr. Keilhack supposes that at each successive stage the country east of the Oder was largely occupied by dammed-back water, and that as the ice retreated this water found an outlet at successively lower levels. In this way he accounts for various series of terraces at different altitudes, some laid down in the lakes, others in the valleys of tributary streams. West of the Oder, where the lakes are supposed absent, we see instead broad sand-covered valleys, the minor relief of which is due to post-glacial erosion. Dr. Keilhack describes fully the various classes of lakes met with, defining seven according to their mode of origin, and concludes by discussing briefly the effects of erosion both by glacial and post-glacial streams, by the sea, and by the wind. It should be mentioned that Herr Herden ascribes the north and south sections of the modern rivers to the erosion of sub-glacial streams, the channels being utilized and deepened by the main currents after the retreat of the ice.

The Lakes of the Black Forest.—Dr. Halbfass has continued his limnological studies in Germany, by a survey of the lakes of the Black Forest, the results of which he has given in the eleventh number of *Petermanns Mitteilungen* for last year. Almost all the lakes lie in the highest parts of the district, the two most important groups being those in the neighbourhood of the Hornisgrinde in the north, and of the Feldberg in the south. The latter group contains the two largest lakes, Titi and Schluch, with lengths of between 1 and 2 miles, all the rest being merely small tarns. Of the Hornisgrinde group the most important is the Mummelsee, which likewise lies at the greatest altitude (3385 feet), and stands first both as regards maximum and mean depth (56 and 24 feet). It is fed by springs only, while the rest of the group are supplied by streams. Its water is coloured brown by humus, but is very clear and transparent. As regards the origin of the Hornisgrinde lakes, Dr. Halbfass says that the old idea that they are due to landslips has now been given up, there being nothing in the configuration of the ground or in the nature of the rocks (horizontally bedded sandstone) to suggest such an explanation. Like the other mountain lakes of North Central Europe, with which they present many analogies, the lakes of the Black Forest must be regarded as the outcome of the glacial epoch, a special point in favour of this view, in the case of the Hornisgrinde group, being the fact that they all lie on the eastern flank of the main ridge, the gentler slope of which is more favourable to the formation of glaciers. Dr. Halbfass does not attach much weight to the prevalence of westward-blowing winds. The chief evidence of glacial action lies in the cirque-like basins in which the lakes (themselves circular) lie, and which also occur again and again where there are now no lakes; and in the moraine-like nature of the dam which holds back the waters. This latter is best seen in the case of the Mummelsee and others which have no influent streams. The fact of the gradual decrease in depth in the direction of the dam would be accounted for by the action of the glacier in pushing forward and heaping up the smaller *débris* of the ground-moraine, while the varying altitude of the lakes (the lowest is at 2585 feet) would imply a gradual retreat of the glaciers. Of the two largest lakes already mentioned Dr. Halbfass gives more detailed information. The Titisee, the largest of all, though not the longest, is remarkably regular in its contour, its sides sinking gradually and evenly to its deepest part, which (at the present day, though not formerly) is nearly central. It thus has a very gradual angle of slope

(only 6¼°), and no extensive level floor. Contrary to the general rule, its higher eastern shore has a more gradual slope than the western. Of the glacial origin there can hardly be a doubt, as the most important glacial deposits of the whole Black Forest occur in its neighbourhood. The Titisee receives the outlet of the Feldsee, a small but deep tarn (105 feet), which alone of the lakes of the Black forest presents the appearance of a true high-level mountain lake. The Schluchsee, the longest of the lakes, has a much less regular floor than the Titisee. The deepest basin lies in the broader upper half, but Dr. Halbfass's soundings have revealed the presence of a second basin, divided from the first by a slight ridge, in the lower half. In the deeper basin the under-water slope is again steeper on the side of the lower eastern shore. The longitudinal section shows the gradual shallowing in the direction of the moraine at the lower end, which has plainly diverted the outlet from its natural south-east direction to a southerly one. Dr. Halbfass gives maps and sections of most of the lakes, the latter possessing the advantage of an identical horizontal and vertical scale. The maps would have been improved by the addition of the contours of the shores of the lakes above water-level.

Austrian Explorations in the Balkan Peninsula.—During last autumn, Dr. Karl Östreich carried out, on behalf of the Vienna Geographical Society, a journey of exploration between Üsküb (Skoplje), on the upper Vardar, and Sjenica, in the Sanjak of Novibazar, a stretch of country which, joining on the west that lately explored by Dr. Hassert, had for the most part been never previously traversed by a scientific traveller. Although the route lay through places of the worst repute in Albania, Dr. Östreich was able to carry out his programme to the letter, and has returned with a rich harvest of topographical, geological, and ethnological observations. From Üsküb (950 feet) an ascent was made of the north-east buttress of the Šar Planina, the Ljubotrn, and its height determined as 8000 feet. The journey was then continued in a generally north-north-west direction, past Kalkandele (1400 feet), and across the Šar Planina; the second highest peak of the range—the Kobilica, north-north-west of Kalkandele—being ascended, and found to have a height of 6000 feet. The ridge between this summit and the Ljubotrn runs with a smooth outline at an average height of 6500 feet. It is a remarkable fact that this main north-easterly section of the range is not designated by the inhabitants of the district by any general name, and only the portion west of the line joining Kalkandele with Prizren is known as Šar Planina. Near Prizren (1700 feet), on the northern base of the Šar group, the small lake of Bresna was discovered, which is apparently the remnant of a larger tertiary basin. Djakova (2900 feet) was next reached, in part through the precipitous gorge of the Drim (such, not Drin, is the correct spelling). There great disorder reigned, by reason of the bloody feud which the year before had broken out between two of the most important families of the place, and which had laid half the town in ruins. The bazaar had been closed for fully six months, the greatest calamity which can befall an Eastern town. The Turkish authorities had, however, finally succeeded in restoring peace, by bestowing posts of honour on the leaders of the rival factions, and so separating them and removing them from the district. The broad high plain which abuts on the south-east base of the North Albanian Alps, between Djakova and Ipek, with an altitude of 1500 to 1800 feet above the sea, is fertile and carefully cultivated in the neighbourhood of the villages, which presented a clean appearance, but in which each house is a miniature fortress. Ipek (1800 feet) lies at the mouth of a narrow ravine. On ascending to the heights of the North Albanian Alps, the landscape reminded the traveller of the limestone Alps of Upper Swabia. The pass north of Ipek has a height of 5600 feet, and the mountains in the vicinity, of about 7000. Hence Dr.

Östreich descended to Ražaj, on the upper Ibar, still at an elevation of 3300 feet, and proceeded almost due north to Sjenica (3500 feet), across the district of the "Peštera," which has hitherto remained almost entirely unknown. Sjenica had been supposed to lie at a greater elevation. The Peštera forms two terraces, respectively about 4600 and 5300 feet high, with "karst"-like surface and subterranean streams in places. Dr. Östreich finally explored the district between Sjenica and Mitrovica, travelling by way of Novibazar and making excursions in various directions.

ASIA.

The Danish Expedition to the Pamirs.—Lieut. Olufsen has communicated to the Paris Geographical Society some details respecting his work in the Pamirs during last summer (*Comptes Rendus*, 1898, p. 458). In August and September surveys were made of Yeshil-kul and other lakes in its vicinity. A point on the north shore of Yeshil-kul, near the mouth of the Marchenai, was fixed astronomically as in 30° 47′ 50″·9 N., 72° 51′ 33″ E., or about 5 miles west of its position in the Society's map. Soundings of the lake gave a maximum depth of 130 feet, the bottom being composed of granite and decomposed clay-slate. A number of sulphureous springs were discovered near the lake, their temperature varying from 67° to 168° Fahr. The small lake Bulun-kul is nowhere deeper than 7 feet, and its bottom is covered with aquatic plants; it seems to have once formed a continuous sheet of water with Yeshil-kul. Hence the expedition proceeded to Wakhan and Ishkashem, discovering many ruined fortresses of the Siah-posh Kafirs. One of these, placed at a height of 2000 feet above the Panj, measures over 7 miles in the circuit of its walls and towers. Lieut. Olufsen had made an excursion among the mountains to the south-west, and had come upon eight villages, whose inhabitants lived in complete isolation. Some geyser-like fountains of sulphureous water were seen, of heights varying from 40 to 100 feet, and the country round is compared to the Yellowstone park. The expedition had taken up its winter quarters at Shorok, at the junction of the Gund with the Panj. Up to November 5 no snow had fallen in the valley, and the temperature ranged at the time from 19° to 46° Fahr.

French Railway Projects in Indo-China.—Now that the French authorities in Indo-China have seriously taken in hand the question of improving the means of communication in that territory by the construction of railways, there is no lack of articles in French papers on the various projects which have been put forward for the carrying out of the undertaking. A concise summary of the measures proposed for the immediate future is given by M. Servigny in the January number of the *Revue Française*. With the exception of a short line in Cochin-China and another in Tonkin, French Indo-China at present possesses no railways, but the welcome event of a surplus in the budget during the past two years, in place of the customary deficit, has enabled the governor-general to obtain a loan of 200,000,000 francs (£8,000,000) with which to commence operations. To completely meet the needs of the territory, the programme would have to include a line along the coast for the whole distance from Saigon to Hanoi, with various transverse lines, including a prolongation to Yunnan; but, as a beginning, a more moderate aim must be kept in view. The lines to be undertaken first are as follows: (1) from Haiphong to Hanoi and the Chinese frontier at Laokai (250 miles); (2) from Hanoi southwards along the coast to Vinh (200 miles); (3) from Turan along the coast to Hue and Kwang-tai, a little north of that town (120 miles); (4) from Saigon north-east to Khan-hoa, with a branch inland to Lan-biang (400 miles); (5) Mytho, in the Mekong delta, to Kantho (61 miles). The total expense of these lines is reckoned at 196,000,000 francs. M. Servigny briefly explains the benefits which will be derived from each of these lines, such as the

connection of Hue with its natural port, Turan, and with the starting-point of the road under construction towards the Mekong; the provision of easy access from Saigon to a sanatorium in the hills, and so on. The coast lines will be advance sections of the future trunk line from end to end of the country, while in time a line may be made from the coast to the Mekong at Kemarat. In addition to the above lines, the prolongation of the Laokai line to Yunnan, for which the French have obtained a concession from the Chinese Government, will be carried out under a guarantee on the part of the French Government for seventy-five years.

AFRICA.

Survey of the West Shore of Lake Rudolf.—Captain Austin, second in command of the Macdonald expedition in East Africa, writes from Save (Mount Elgon), under date November 18 last, giving some account of his surveys in the country to the north as far as the lower Omo river. His route lay down the course of the Turquel and along the west shore of Lake Rudolf to its most northern point. This he considers to lie further north than it has hitherto been placed, probably almost up to the 5th degree of north latitude, and as he succeeded in getting north and south stars for latitude nearly every night, his observations should be dependable. The western shores are broken by numerous small lagoons, separated from the open water by low sand-bars. Many evidences of a westward encroachment of the lake were noticed, such as palm-trees surrounded by water and partially submerged. At one point they extended 2 or 3 miles into the lake. The Turquel, though it has a good flow in its upper reaches, probably never reaches the lake, but is absorbed by the sandy soil. Some 5 miles from the lake, its bed is often half a mile wide, with densely-wooded banks. Water is obtained from wells in its bed, and a few patches of alluvial soil on its banks are cultivated by the Turkana. The country round is excessively arid, and incapable of producing anything. The river at the head of the lake, called by the natives Murtoni, is the finest stream in this part of Africa, except the Nile, and is probably the only perennial feeder of the lake. The name Basso Norok, applied to the latter, appears to be an invention of the Swahili, its native name being Nanam. The water is unpleasant to the taste, but abounds in fish, crocodiles, and hippopotami, while the lagoons are much frequented by water-birds. We hope soon to publish a map embodying the work of Captain Austin and the other members of Major Macdonald's expedition.

Captain Wellby's Journey in North-East Africa.—Writing from Addis Abeba on December 16th, Captain Wellby announces his intended start, in three days' time, for the south. His plan is to proceed by Zakwala hill to Lake Zuai and the lake south of it, and to strike the Omo in 7° N., following it down to Lake Rudolf. His party consists of forty men—Abyssinians, Gallas, Somalis, and Sudanese, —with fifty baggage animals. He hopes to carry on plane-table work throughout, on the scale of 4 miles to the inch, and also to take latitudes, heights, and other observations. The party was provided with supplies, calculated to last three or four months without replenishment, and had with it a canvas boat for crossing rivers. From Lake Rudolf, as already announced, Captain Wellby hopes to strike the headwaters of the Sobat, but his plans are not yet definite. He speaks in glowing terms of the agricultural wealth of Abyssinia, and says that the people are far better than he had anticipated.

Journey East of the Upper Congo.—One by one the last unexplored districts are disappearing from the map of Africa. One of the most out-of-the-way of these, the forest-clad region between the Manyema country and Count von Götzen's route, was last year traversed by a Belgian military expedition from the upper Congo, under Lieut. Glorie, sent in pursuit of the revolted Batetelas. A short account of

the journey, accompanied by a sketch-map, is given in the sixth number of the *Mouvement Géographique*, and gives a general idea of the country passed through, though somewhat confused as to details. The expedition left Riba Riba in April, 1898, and first ascended the valley of the Elila (Lira of Stanley) as far as Misisi, the road lying entirely through forest, in which, however, there are few large trees. From Misisi a north-east course was taken to the Ulindi, which proved an important stream, with a general width of 60 to 100 yards. The country traversed was generally flat and still wooded, and no villages of importance were seen; they must, however, exist, as clearings were constantly met with, and provisions were abundant. At Shabunda, where the Ulindi was struck, a chief is established who originally came from Ujiji. His village contains about 8000 inhabitants. Hereabouts the country becomes more broken, and though no well-marked chains of mountains are seen, the whole surface seems to form a *massif* running from north to south from near Lake Albert to Manyema, and forming the western versant of the Central African plateau. The rivers which flow west to the Congo have excavated deep tortuous channels, and the whole region is one of the most picturesque imaginable. The highest summits reach an altitude of over 5000 feet. Along the Ulindi the population is generally scanty, but Tata (heard of by Stanley in 1876) is thickly peopled. At a point not easily recognizable from the description the forest suddenly ceases, and an open plain is reached, covered with short fine grass. This country is known as Utembo, and its inhabitants are tall, well made, and warlike, fighting chiefly with spears. The Belgian expedition seems to have gained a passage through their country by force of arms. Each family possesses several head of cattle, as well as goats and sheep, and the groups of huts are surrounded by thick plantations of bananas. Until the middle of June rain fell about every other day, but then became less frequent, ceasing early in July. The expedition reached its goal at the village of Gwese, near the Rusizi, lying almost on the water-parting between the direct tributaries of the Congo and the basin of Lake Tanganyika. Its altitude is 5000 feet.

The Anglo-German Boundary Commission between Nyasa and Tanganyika.—Mr. Alfred Sharpe sends us some notes on the work of the joint commission which last year delimited the Anglo-German boundary north of Nyasaland. The English party consisted of Captains Close and Boileau, Lieut. Scratchley, and assistants, who commenced work in June, and had before December surveyed the whole boundary from lake to lake. All longitudes were based on that of a point on the telegraph line, inland from Nkata bay on Lake Nyasa, which was telegraphically fixed from Cape Town with a high degree of accuracy. In defining the 33rd meridian, on which the frontier as agreed upon in 1890 depends, it was found only 1100 yards distant from a point provisionally fixed by Mr. Sharpe and Lieut. Rhoades in 1897, working from O'Neill's position for Blantyre. Mr. Sharpe says nothing about the slight modification of the boundary involved by the discovery that the Songwe does not cross the 33rd meridian, so it may be supposed that the provisional arrangement alluded to in the *Journal* last year (vol. xi. p. 300) has been upheld. He says that he hopes to arrange for the suitable commemoration of the spot where Livingstone died during the coming dry season. The state of Nyasaland is reported as hopeful, a very large coffee crop being anticipated, and the rubber trade showing an increase.

The Museum of the Khedivial Geographical Society of Cairo.—On December 12 last, a museum of geography and ethnology in connection with the Khedivial Geographical Society was formally opened by the Khedive, in the presence of a gathering composed of ministers, members of the diplomatic and consular bodies, and others. An address was delivered by H. E. Abbate Pasha,

setting forth the scope and objects of the museum, which is intended to bring together into one view collections representing the history and geography of Egypt and neighbouring territories from the original deposit of the Nile alluvium down to our own times. Although at present a nucleus only has been got together, it already possesses a valuable collection of maps—ancient and modern—portraits of great travellers, and so forth. An interesting point touched upon was the connection of the word "museum" itself with the ancient Egyptian *mes*, "a temple."

AMERICA.

Exploration of Alaska.—The impetus given to exploration, in Alaska no less than in British territory, by the recent gold discoveries, has been such, that during last year no less than six overland exploring parties were sent out by the United States authorities. A brief sketch of the work performed appears in the fifth number of the *Bulletin* of the American Geographical Society for 1898. The objects held in view are described as primarily the determination of the limits of the gold deposits, and incidentally the study of other resources of Alaska and of the facilities for railway and road making within that territory. Four expeditions were sent out by the Geological Survey, and two by the Army, a geologist being also attached to each of the latter. Two of the geological expeditions, under Messrs. Eldridge and Spurr respectively, started from the head of Cook's inlet, striking one north-east, the other north-west towards the Yukon; the other two (under Messrs. Peters and Barnard) reached the upper Yukon by the White pass; but whereas the one subsequently struck across from the White river to the Tanana, and down the latter to its mouth, the other held on its way down the Yukon, and executed a detailed survey over a large area east of Circle city, along the Dominion boundary. The two army expeditions, under Captains Glenn and Abercrombie, left the coast at points between the Copper river and Cook's inlet, and struck north and north-east by roughly parallel routes to the middle Yukon. Mr. Eldridge's route lay up the east branch of the Sushitna river (cf. *Journal*, vol. xi. p. 70), and he was able *en route* to fix approximately the position and height of Mount Bulshaia, already reported by prospectors. He gives the latter as 19,500 feet, which would make it the highest summit in the States. In the map which accompanies the paper, Mount McKinley, which has before been spoken of as identical with Bulshaia, is placed further north. Mr. Spurr's party crossed over to the headwaters of the Kuskokwim, down which they floated, and, after diverging to the lower Yukon, reached the mouth of the former river, and carried out further explorations along the coast and across the Aliaska peninsula. The difficulties encountered by all the expeditions were naturally great, and some lives are reported lost during the crossing of the Valdes glacier near the Copper river, by Captain Abercrombie's party. In addition to the above work, a survey of the Yukon delta was carried out by the Coast and Geodetic Survey, with the important result that a sufficient depth of water was found in one of the little-known southernmost channels, to permit the passage of ocean-going vessels.

Winter Journey in the Northern Rocky Mountains.—In the first number of the new volume of the Italian Geographical Society's *Bulletin*, Dr. D. R. de Simone gives a short account of a journey made a year ago through Northern British Columbia, across some of the wildest and least frequented parts of the Rocky mountains. Being in San Francisco at the height of the Klondike gold-fever in 1897, Dr. de Simone made up his mind to try to reach the Yukon overland from Vancouver, and chose the winter in order to avoid the difficulties arising from flooded streams. Arrived at Quesnelle, on the upper Fraser, January 5, 1898, most of the party who had accompanied him so far gave up the enterprise, and he proceeded with one companion only, a Norwegian miner named Johnson, to Fort

Conelly, on the upper Skeena. Here he obtained the services of three of the wandering Sikni Indians, who undertook to lead the way to the Omenika, one of the headstreams of the Peace. But after passing through a labyrinth of ice-covered mountains, the travellers found themselves on a more northern stream, the Inginika, and with difficulty made their way to Fort Graham, on the Finlay. An attempt of the Indians to desert by night with the sledges and provisions was only frustrated by the sagacity of Dr. Simone's St. Bernard dog. From Fort Graham the Finlay and its tributary the Thudaka were ascended, and pushing on desperately through the mountains, Dr. de Simone and his one companion at last struck the Stikine, and proceeded by Dr. Dawson's route of 1887 to the Liard. Thence they again struck west across the Kassiar range to Lake Teslin, on the eastern route to the Yukon. Their supplies being almost exhausted, and themselves threatened with scurvy, they now turned their steps southwards to Telegraph creek and Fort Wrangel. The rigour of the season and other difficulties of the journey precluded the possibility of any surveys. The country traversed is described as covered with dense bush and forests of huge conifers, the valleys and plains among the mountains being frequented by cariboo, bears, foxes, martens, etc.

AUSTRALASIA AND OCEANIC ISLANDS.

Australian Place-names.—The fifteenth volume of the *Transactions* of the Royal Geographical Society of Australasia (Victorian Branch) contains a paper by A. J. Wright on the nomenclature of an Australian colony. After showing how Australia differs from other parts of the world as regards its place-names from the low grade of its aboriginal inhabitants and their want of history, he expresses regret that better use has not been made of the opportunities afforded for introducing a well-considered and appropriate nomenclature. The names bestowed by the earliest colonists were on the whole dignified and euphonious, but the inrush of adventurers to the goldfields led to the conferring of grotesque and repulsive names which cannot be considered desirable. There is a great want of names recording natural features of the country, or trees, birds, and animals once common in districts now deserted by them, which would have been both interesting and instructive to future students. The suffixes which in English place-names are of so much use in indicating natural features of the past are altogether wanting in Australia. Another opportunity neglected has been that of recording the names of many of the early explorers on the map, while we do find other names having no connection with the colonies or their history. Mr. Wright also objects to the illogical application of native or pseudo-native words to centres of colonial industry, as leading to false conceptions. It is indispensable, in his opinion, that names should have some *raison d'être*—should describe or commemorate something, and this condition is not fulfilled in the case of the outlandish native names, which are out of all proportion to the native element in the population. Much more appropriate, he holds, would be the adoption of names connected with the past history of the Anglo-Saxon race, and especially of those men who by their wisdom or valour contributed to the welfare of the colonies. This part of the paper was the subject of some criticism in the discussion which followed, most of the speakers supporting the retention of native names.

Trigonometrical Survey Work in New South Wales.—According to the last annual report of the Department of Lands, New South Wales, the amount of trigonometrical survey work executed during 1897 was as follows: The main triangulation has been extended southerly along the coast to Wolumla station, thence westerly to Coolangubra (new) and Bukalong stations, and northerly to Glenbog station. Astronomical observations were made for determining latitude

and azimuth at Wolumla, Glenbog, and Cooma stations; 2181 horizontal angles were measured, 184 stars were observed for latitude, 184 stars for azimuth, and 23 stars for time. At Cathcart, Stannard, Wangrah, and Cosgrove stations, 1167 horizontal and 648 vertical angles were measured. Magnetic observations were also made at those stations. Reserves for protection of stations were measured at Bimmil, Wolumla, Cathcart, Glenbog, and Stannard. A series of check levels was run between Bimmil station, and a bench-mark on the trial survey for a railway line between Bega and Eden. Observations were made at Wadbilliga, Bemboka, Burragate, Imlay, Skelton, Mowwarry, and Nagha stations; 1942 horizontal angles and 491 vertical angles were measured. Magnetic observations were also made at these stations. Reserves for the protection of fifteen stations were measured and marked, and seven connection surveys were carried out. Twenty new stations were piled and cleared in counties Buccleuch, Harden, and Wynyard, and the necessary reserves and connections measured. Twenty-five new stations were also formed in counties Cowley, Buccleuch, Wallace, and Wellesley, and the necessary reserves and connections measured.

Rabbit-proof Fences in New South Wales.—A few notes are given in the last Annual Report of the Department of Lands, New South Wales, regarding the progress of the measures adopted by the Queensland and New South Wales Governments to cope with the rabbit pest. The erection of a rabbit-proof fence from Mungindi, on the Queensland border, to the Namoi river, at Bugilbone, a distance of about 115 miles, was completed in March, 1897. Suggestions have been made for the continuation of this fence, from its termination at Bugilbone, either in an easterly direction to Narrabri, or southerly to the rabbit-proof fence on the boundary of Wingadee pastoral holding. The erection of the latter line of fencing, and the bridging of a gap which separates the netting fences on the boundaries of Goorianawa and Goolthi pastoral holdings, would bring into existence an additional barrier, some hundreds of miles in length, which would protect nearly the whole of the counties of White and Baradine, including the well-known Pilliga scrub, and practically render the greater part of the north-eastern portion of the colony free from the inroads of the pest. The aggregate number of miles of rabbit-proof fencing erected in the colony has increased to 17,280. A map illustrating this subject is given at the end of the report, which shows that along the whole western boundary no rabbit can cross the frontier, while two-thirds of the northern boundary is similarly protected. The work is thus not one of merely local interest, for it may be said to add a new type of boundary—the artificial biological barrier—to those hitherto recognized in political geography.

Government of Dutch New Guinea.—A note in the *Geographische Zeitschrift* (1899, part 1) announces that the Dutch authorities have at last determined to bring their portion of New Guinea under a certain degree of control, their suzerainty having, since the evacuation of Fort Du Bus in 1838, been exercised solely through the Sultan of Tidore, their vassal. Two commissaries will in future represent the Dutch power directly, each supported by a small force of armed native police commanded by a European, and provided with a steam-launch, also manned by natives. The headquarters of the commissaries will be Manokwari, on Dore bay, for North New Guinea, and Fatak, in the Kapar district, for the south-west.

POLAR REGIONS.

Swedish Andrée Search Expedition.—The energetic Swedish arctic explorer, Dr. Nathorst, has issued an appeal for funds in aid of an expedition to search for Andrée next summer along the east coast of Greenland. It is the opinion of many experts, Dr. Nansen included, that this is the most likely direction for the balloon

to have taken, and it is still hoped that Andrée and his companions may have landed in that region. Should they have proceeded along the north-west coast, they may have already fallen in with Peary or Sverdrup, and be now in safety, but should they have tried to advance southwards along the coast, they would find no inhabitants before reaching Angmagsalik, in 65° 50′ N. Dr. Nathorst therefore insists on the importance of searching the coast between 73° and 76° north, and reckons that an expedition for this purpose will involve an expenditure of 70,000 kronor, including repairs, etc., to the *Antarctic*—which will be at the disposal of the search-party—supplies, and scientific equipment. On February 13 it was reported that 30,000 kronor had already been promised. The report that the bodies of Andrée and his two companions, with remains of the balloon, had been found in the interior of Siberia is regarded as without foundation.

MATHEMATICAL AND PHYSICAL GEOGRAPHY.

Professor Geikie on Land-forms.—The new Progressive Science Series, published by Mr. Murray, and edited by Mr. F. E. Beddard, contains several volumes devoted to departments of physical geography by writers of high eminence. Of these Prof. James Geikie's work * has a special interest to geographers, on account of the plan which he proposes for the nomenclature and classification of land-forms. The leading land-forms are given as "Plains, plateaux, hills and mountains, valleys, basins, and other hollows and depressions of the surface, and lastly coast-lines." *Plains* are recognized as regions which are approximately flat or gently undulating, and as a rule of slight elevation, and they are divided, according to the mode of origin of their superficial layers, into plains of accumulation, the surface of which corresponds to the internal geological structure and plains of erosion, the surface of which bears no necessary relation to the structure. *Plateaux*, or tablelands, are not sharply distinguished from plains, and are classified in the same way, the tendency of plateaux to be cut up into segments by erosion being noted. *Hills* and *mountains* are not clearly separated, but the limit of 1000 feet of elevation is suggested as the minimum to which the name of mountain should be applied; but, for purposes of classification by structure, the term "mountain" is used to include both. Two great divisions are recognized: (*a*) Original or tectonic mountains, subdivided into mountains of accumulation (volcanoes, sand-dunes, etc.), and of deformation (including folded or flexured, dislocation, and laccolith mountains); and (*b*) Subsequent or relict mountains, produced by denudation, and comprising many typical forms due to the action of erosion on different geological structures, resulting in synclinal mountains, escarpments, and necks. *Valleys* are similarly divided into original or tectonic, formed either by hypogene action or by epigene action other than that of running water (including constructional and deformation valleys, the latter subdivided into dislocation and synclinal valleys) and subsequent or erosion valleys produced by the work of running water. *Basins* or hollows in the surface are classed according to origin as tectonic, volcanic, dissolution, alluvial, æolian, rockfall, and glacial. *Coast-lines* are distinguished into regular or smooth and irregular or indented. The author keeps before the reader constantly the great fact that the only clue to the classification of land-forms is the history of the evolution of the land surface.

The Asymmetry of the Northern Hemisphere.—Under this title Prof. Suess summarizes our knowledge of the great structural lines of the northern hemisphere, as derived from the recent investigations of geologists, in the 'Reports' of the Vienna Academy of Sciences (*Math. Naturw. Classe*, vol. 107, p. 89). He

* 'Earth Sculpture, or the Origin of Land-forms.' By James Geikie, LL.D., D.C.L., F.R.S. London: John Murray. 1898.

lays down the following great systems of mountain folding: A series extends over Northern Asia from the Kanin peninsula to Bering sea, which either differs entirely from the great Eurasiatic system or does not fall in with the general plan of the latter. The folds are concave towards the pole, and curved towards the west, south, or east. They have no equivalent in North America, except possibly in the coast ranges of British Columbia. Next, a great amphitheatre, also concave towards the north, surrounds Lake Baikal and the East Siberian plain; the whole great series of curves from Sakhalin to Java, and to the Himalayas and the Persian gulf, possesses in its broad features a homologous arrangement. The next system starts from the Thian Shan, and is continued through the Central European ranges to the Hebrides; it follows to a certain extent the Asiatic arrangement, and is to be considered as an extension of the latter. As regards its relations to the Atlantic, the conclusion may be drawn that, while certain of the lines were never continued beneath the ocean, a wide archæan region once occupied its northern basin—a conclusion also borne out by facts observable in eastern North America. The general system of folds in the latter continent differs from that of Eurasia, in that they are concave, due to a motion of the mass inwards; the European chains form the intermediate link between the Asiatic and American structure. This difference in structure between Asia and America (which has given rise to the divergent views as regards the continents and their relation to the oceans which have found favour with the students of the two regions) justifies the conclusion that a lateral asymmetry has existed in the northern hemisphere ever since the Cambrian epoch. As regards the question of the permanence of oceans and continents, therefore, the general conclusion is that since the epoch just named the positions of the regions of outward and inward movement and of the lines of surface tension have remained the same in the northern hemisphere, though a similar degree of permanence does not apply to the oceans. The outlines of the continents and seas change in spite of the continuity of the fundamental lines.

GENERAL.

The Sites of Great Commercial Centres.—In the *Bulletin* of the American Geographical Society (1898, No. 4), Major A. F. Sears discusses the geographical conditions that make great commercial centres, endeavouring to lay down a general rule to account for the positions they occupy. The keynote of the discussion is the statement that trade always follows natural, not artificial laws. The paper is thoughtful and instructive, though perhaps too much prominence is given to one determining factor, to the exclusion of other possible causes. From the consideration of a number of instances, mostly taken from the United States, the author deduces the law that trade will always come as near as possible to the centre of production of a country, even passing by commodious harbours easily reached from the ocean, and, to attain the above end, choosing others which may involve difficulties of navigation or considerable addition to the length of the voyage. Thus Boston, in spite of being nearer to Europe and of the amount of capital expended on the port, has had to give way to New York, which is over 200 miles nearer the centre of the country. In a similar way the position of Philadelphia, Baltimore, Houston, New Orleans, and many other ports, is explained, as also the growing importance of Montreal as compared with Quebec. On the west coast, Portland has in the same way flourished at the expense of Astoria, Kalama, and St. Helen's. The reason for the importance of Seattle, as compared with Tacoma, cannot be thus explained, but Major Sears says the "producing region" does not lie in the direction of the last named. In the region of the lakes, however, the positions of Cleveland, Detroit, and especially Chicago, are explained from their nearness to the heart of an

exceedingly productive country. In Europe, the Irish ports, as also Glasgow, London, and Hamburg, are cited as instances. The writer attempts, not always quite satisfactorily, to account for apparent exceptions to the law, which he holds to be in reality "without exception in the world's economy." The position of San Francisco is accounted for as due to the need of accessibility to the numberless little inlets along the Pacific shores. The trade of New York has not gone further up the Hudson, because it is the port not of the valley of that stream, but of half the continent. Liverpool has not declined since the opening of the ship canal, because it is as near a large part of the producing area as Manchester. Other great ports, not touched upon, could hardly be brought under the action of the law, as, *e.g.*, Aden, Hong-Kong, Singapore, and Zanzibar, and this seems to show that other causes must also be taken into consideration, in order to render the study complete from all points of view. It will be seen that the commercial centres spoken of are all *ports*, and the law is, after all, chiefly an outcome of the fact that water-carriage is cheaper than land-carriage.

Kubary's Ground-dove.—The ground-dove of the Caroline islands, discovered by Kubary, and named after him by Dr. Finsch (as mentioned above, p. 107), is *Phlogœnas Kubaryi*, not "*Phlegyas*," as there incorrectly written. It is a fine species. There are four specimens of it from the island of Ruk in the British Museum. Two of these were obtained by Kubary himself, and two by Dr. Finsch, who visited the Carolines in 1880. See Dr. Finsch's Ornithological Letters from the Pacific in the *Ibis* for 1881.

CORRESPONDENCE.

Hannibal's Pass: Some Points on the Classical Authorities.

My friend Mr. Bullock Hall's very interesting work, 'The Romans on the Riviera and the Rhone,' has recalled me to the old subject of Hannibal's pass, which has always attracted me, perhaps from a lawyer's fondness for weighing evidence. And I am presumptuous enough to think that there are one or two sides of the question not yet exhausted, attention to which will tend to confirm the opinion in favour of the Argentière which Mr. Douglas Freshfield has so ably maintained in the *Alpine Journal*, No. 81, and in the *Proceedings R.G.S.* for 1886.

First, in Hannibal's time the world of the Romans comprised the plains of the Po as far as the Insubres inclusive, or, at any rate, as far up as the hills of Montferrat and Asti, but the screen of hill and mountain to the west, and Gaul beyond it, were beyond their ken. Hannibal's operations were therefore well known to them from the time of his contact with the Insubres, but any details which they may have heard about the way by which he reached that point would, at the best, be complicated with names of places or tribes conveying to them no clear geographical notions. They would be ill understood, and probably worse repeated and handed down. But from the time when the Romans penetrated into the region between the Alps and the Rhone they inevitably became acquainted with the country which they governed, and with the traditions of the great Carthaginian's passage through it which the tribes must have preserved, and the details concerning that passage must have been matter of keen professional interest to the Roman commanders. Then, at any rate, they knew the truth about Hannibal's route and pass. The case is therefore one in which the later authorities are to be preferred to the older. When we try to enumerate the older authorities which any later author, as Livy, had before him, in order to arrive at a measure of his trustworthiness, we suffer under an illusion as to the latter's sources of information arising from the painful examination

of texts from which we are obliged to draw our own knowledge. Livy and his contemporaries wrote of and from what was familiar and certain knowledge to all about them who had any connection with provincial affairs. Varro was not only the most learned man of his age, but was himself a general and had been employed as such in the region, and to dispute his statement on the point would be no wiser than for a critic of the year A.D. 3000 to dispute the statement of a French staff officer of the year A.D. 1900 as to the pass by which Napoleon crossed the Alps before the battle of Marengo.

Secondly, Varro's statement that Hannibal passed by the Argentière is so clear as scarcely to admit of misinterpretation, but since Livy mentions no topographical name after the Durance it has been thought that his account will apply to the Mont Genèvre equally with the Argentière. This, however, I submit is a mistake. According both to him and to Polybius it was before the attack on the city of the Taurini that Hannibal allowed his troops an interval of rest, the duration of which (*stativis*), and the abundance and comfort which they enjoyed in it, Livy emphasizes. Now this was possible in the rich plains between the foot of the Argentière and Turin, but scarcely so on the descent from the Mont Genèvre, that is in the narrow valley of the Dora Riparia, or in the very short strip (7 miles) of plain country between the entrance to that valley and Turin. Even therefore if Livy were our only witness to what was known at Rome in his time, I should feel myself obliged to conclude in favour of the former pass, in happy consonance, as the fact stands, with Varro.

Thirdly, Polybius is usually quoted as a single authority, but it appears to me that we have two accounts from him written at different periods of his life. When he composed the narrative in his third book he did not know which was Hannibal's pass, or, indeed, anything very clear about his route; the statement that Hannibal's pass was that through the Taurini, which Strabo quotes from him, was most likely made in his thirty-fourth book, which is said to have been a sort of treatise on geography, but was, at any rate, made after he had lived to share in the knowledge which was acquired through the advance of the Romans into Gaul. In his third book, when he tries to arrive at the total length of march from Carthage to Italy, Polybius says that from the passage of the Rhone to the beginning of the ascent of the Alps there are 1400 stadia for those who follow the very river in the direction of its source—*πορευομένοις παρ' αὐτὸν τὸν ποταμὸν ὡς ἐπὶ τὰς πηγάς* (Hist. iii. 39). This means that he does not profess to give the distance actually marched by Hannibal through districts unknown to him (Polybius), but gives the known distance along the river as the nearest approximation to it that he can. Accordingly, when he says that, after his halt among the Allobroges, Hannibal marched 800 stadia in ten days to the beginning of the ascent of the Alps, he no longer speaks of the very river, but uses a looser expression—*παρὰ τὸν ποταμόν* (iii. 50). Of course this would be translated "along the river" if it stood alone, but the significant contrast with *παρ' αὐτὸν τὸν ποταμόν* obliges us to translate it by "parallel to or in the general direction of the river." Whether the march was really in that general direction, at least above the confluence of the Drac, is a matter on which the geographical insufficiency of Polybius is now too well understood for his statement to carry any weight.

Here the question may be incidentally noticed, What river did Polybius mean, the Rhone or the Isère? He meant neither, as such, whether in iii. 39 or in iii. 50. He had in his mind, as a kind of standard from which Hannibal deviated, the trade route over the Little St. Bernard; and his "river" was the river along which that route passed, namely the Rhone as far up as the junction of the two, and the Isère above that point.

When, later, Polybius became aware that Hannibal crossed the Alps by the Argentière, he described it as the pass "through the Taurini" without any practical ambiguity for his time, because the Mont Genèvre was opened afterwards by Pompey, and the Mont Cenis, though Varro tells us that Hasdrubal used it, was not much known. He did not alter or add to what he had written in the third book, because he well knew that he had not there named or identified the pass, so that the description, which he meant to be as vivid as he could make it, needed no correction or completion.

Fourthly, the language in which Varro, as quoted by Servius on Virgil, describes the first two passes, reckoning from the Mediterranean, is just a translation of that which Strabo quotes about them from Polybius, except that the words "through the Taurini" are omitted from the mention of the second of them. The Mont Genèvre having been opened and the Mont Cenis become better known, the omitted words were no longer specially descriptive of the Argentière, for all three descended among the Taurini. And thus we have a significant illustration of that gradual growth, in the knowledge of the Alps and what had happened among them, which I submit ought to be taken as a cardinal fact in our appreciation of the authorities. We have three stages before our eyes: the Polybius of the third book of the Histories, the Polybius of the thirty-fourth or some other book, and the final stage of Varro and Livy.

I do not trouble the reader, or even myself very much, with the details of the famous march. They are interesting not only in themselves, but also because the difficulties and hardships so impressed the survivors with whom Polybius talked that their account of them, or what he understood and remembered as such, stood out in his mind apart from any geographical setting, like the scenes in a bad dream which may have happened anywhere or nowhere. But, so far as I am competent to express an opinion, Mr. Freshfield has successfully answered the serious questions which arise, and has given a true representation of the march.

J. Westlake.

Chelsea, January 21, 1899.

'*The Marvellous Adventures of Sir John Maundevile.*'*

Mr. Lugard's new edition of Sir John Maundevile's Travels, being rendered into modern English, is easier to follow than the old editions in the original spelling, and may, it is probable, induce many people to read it who have been deterred by the effort and time necessary to study the old versions. It is illustrated with new designs, of which nothing need be said. What is intended here is to endeavour to rehabilitate the character of this well-known author, whose work has gone through so many editions and been translated into so many languages during the past five hundred years, more, perhaps, than any other traveller, and whose name has been almost made a synonym for falsehood, somewhat unjustly, as it seems to me.

I regret that Colonel Yule† has laid the great weight of his authority against our traveller, who, he intimates, never did travel in the East, but took all his information from Friar Odoric, who travelled in the East in 1316–28. The earliest known notice of this last work, according to Colonel Yule, was in 1348–50. Maundevile's book appears to have been written in 1346, "the 34th year that I departed from our countries." He was, therefore, if we accept his own accounts, on his

* Constable & Co. 1895.

† 'Cathay, and the Way thither' (Hakluyt Society: 1866), pp. 27–29.

travels the whole time that Odoric was in the East, and they may possibly have met. Maundevile in one place refers to two friars who accompanied him. This, according to Yule, is a piece of craftiness on Maundevile's part. There is no doubt that in certain regions his account and Odoric's are nearly identical, and it is quite possible Maundevile may have copied such portions, if he had become acquainted with the contemporaneous work, or they may have been derived from a common source; but even Yule admits that Maundevile's readings of the proper names have positive value for collation, and have suggested amendments of the text (Odoric's). At any rate, Maundevile's account of Egypt is not from Odoric, nor his dissertation on the shape of the Earth, which I have not found treated of anywhere else later than Eratosthenes, of the third century B.C., except in Friar Bacon's great work (of which more hereafter), of whose work he seems to have had some knowledge. As regards the territories of the far East, Maundevile states that he served the great Khan as soldier for fifteen months against the king of Mancy.

With reference to his account of Palestine, etc., being "appropriated" from Odoric, it seems quite as probable that both got their accounts from the monks in that country.

He appears to me, on the contrary, to have been a well-informed man and careful observer, and correct about places he had seen himself, and far ahead of his age in many respects. He was a conscientious, religious man, for does not he relate how the Soldan of Egypt * "wolde have maryed me fulle highly, to a gret Prince's Daughter, yif I wolde hav forsaken my Lawe and my Beleve. But I thanke God, I had no wille to don it, for nothing that he behighten me"? He also tells us plainly about "this Tretys, that I had made after informacioun of men, that knewen of things that I had not seen myself, and also of Marveyles and Customes that I hadde seen myself,"—therefore, professedly, only in part from his own observation.

Then the astute gentleman, on return from his long wanderings, called at Rome on his way home, and "was assoylled of all that lay in my conscience, of many a dyverse grevous poynt." He also showed the Pope his book, which was examined and approved by the Pope's Council. How the Council gave their imprimatur to a book containing the then heterodox doctrine of the spherical form of the Earth, is difficult to conjecture.

Our author, then, I would accept as an honest man, steeped in the credulity of the age, accepting without demur, and in simple faith, all that was told him by the ecclesiastical authorities in Palestine, and believing all the Eastern legends and stories he heard, and incorporating them in his book. He was not the *inventor* of these tales, which, on the contrary, come down from remote antiquity. Herodotus has many of them, and they were then generally believed throughout the East.†

One cannot but be struck by the difference between these wild legends and the sober and accurate accounts of places he had visited, such as Egypt, the Persian gulf, Tartary, etc. His description of the Beduin, for instance is, I think, inimitable, and shows an intimate knowledge of that people, who are now just the same as they appeared to him. To his contemporaries the account of the great Khan's court was, no doubt, not less wonderful or incredible than many of the myths related.

But I am chiefly concerned with him as a scientific geographer, for such is the

---

* These quotations are taken, for their quaintness, from the edition of 1725, from the Cotton MS.

† The sources whence these myths were derived are given in the edition of 1725. They were, in fact, "chestnuts."

title he deserves, as he shows a clear understanding of the sphericity of the Earth, and of its approximate dimensions, with a freedom in discussing the question, which is really surprising, when we consider how original thought was then repressed. In the quotation following, which is rather long, I have followed the modernized text of Mr. Lugard. Sir John's argument is as follows: "From Hindustan" (apparently, judging by the description of the pilgrims letting the car-wheels go over them) "men go by sea and many dyverse Yles and by many countries, fifty-two journeys, to a land called Lamary" (possibly South Africa),* where the people wore no clothes and were cannibals. Now comes the remarkable part—"In that land, and in many others beyond that, no man may see the star Transmontane (Pole star), that is unmoveable, and that is towards the North, that we call the Lodestar. But men see another star, the contrary or opposite to it, that is toward the South, that is clept Antarctic, . . . the which star appeareth not to us . . . For which cause men may well perceive that the land and sea be of *round shape and form*. For the part of the firmament sheweth in one country that sheweth not in another country. And men may well prove by experience and subtle compassing of wit, that if a man found passages by ships, that would go to search the world, he might go by ship all round the world and above and beneath. For I have been towards the ports of Brabant and beheld by the Astrolabe that the star that is clept the Transmontane is 53 degrees high, . . . and farther towards the Septentrional (or northern) parts, it is 62 degrees of height and certain minutes, for I myself have measured it by the Astrolabe.

"Now ye shall know that over against the Transmontane is the tother star that is clept Antarctic as I said before. And those 2 stars never move, and on them turneth all the firmament right as doth a wheel that turneth on his axletree. (Of course neither the Polar star, nor still less any southern circumpolar star, can be said *not* to move.)

"After this I have gone toward the meridional parts, that is toward the south, and I have found that in Lybia men see first the star Antarctic. . . . After going by sea and by land towards this country, of which I have spoken" (he calls it Lamary, a land of cannibals, who go all naked), "and to other isles and lands beyond that country, I have found the star Antarctic 33° of height and some minutes. And if I had had company and shipping to go more beyond, I trow well, as certain, that we should have seen all the roundness of the firmament all about. . . ."

He then explains that by going north 62° 10′, and south 33° 10′ he has seen three parts of "all the roundness of the Firmament, and more yet by 5 degrees and a half. By the which, I say to you certainly that men may environ all the earth of all the world as well underneath as above and return again to their country, if that they had company and shipping and conduct. And they should always find men, lands, and isles as well as in this country. For wit ye well, they that be towards the Antarctic be straight, feet against feet, to them that dwell under the Transmontane as well as they that dwell under us be feet against feet." This is very explicit; and he then relates how he had heard of a man who reached the same "Isle"† starting in opposite directions round the world. He further proceeds with his arguments thus: "But how it seemeth to simple men unlearned that men may go under the earth, and also that men should fall towards the heaven from under. But that may not be, any more than we may fall toward the heaven from the earth where we be. For on whatever part of the earth that men dwell, either above or beneath, it seemeth always to them that they go more

* Sir Henry Yule says this is Sumatra.

† The peculiarity of calling any foreign country an Isle is found also in the 'Arabian Nights.'

upright than any other folk. And right as it seemeth to us that they be under us, right so it seemeth to them that we be under them. For if a man might fall from the earth unto the firmament, by greater reason the earth and the sea, that be so great and heavy, should fall to the firmament, but that may not be. . . ."

He then discusses the size of the Earth, as follows: "For the earth is full large and full great, and holds in roundness and environment about by above and beneath 20,425 miles after the opinion of the old wise astronomers, and this saying I reprove not. But after my little wit it seemeth me, saving their reverence, that it is more. . . ." His conclusion is, "And wit well that after the authors of astronomy, 700 furlongs of the earth answer to a degree of the Firmament, and those be 87 miles and 4 furlongs; now be that multiplied by 360 times, and then they be 31,500 miles 8 furlongs after the miles of our country."

All this seems to me immensely in advance of anything I have found in any writer of that period. Where did he get his ideas from? If, as Yule concludes, he was a mere impostor, and had not really travelled, what I would observe is, that these exact views about the Earth are the more marvellous. Purchas had a different opinion of him, and calls him the greatest traveller that ever the world had. If Maundevile's statement that he had been in 33° S. lat. be anywhere approaching to correctness, he must have been nearly as far as the Cape of Good Hope—probably, chiefly by sea, *vid* the Mozambique. Ibn Batuta, who travelled about the same period, viz. 1325–55, appears certainly to have gone down the Mozambique by sea to 9° S. lat. But if Lamary be Sumatra, as assumed by Colonel Yule, it would appear as if he had visited Australia. I think the former the less improbable. There is little doubt that long before his time there was trade between Arabia, India, and the east coast of Africa, while Australia was apparently undiscovered. In the introduction to Astley's 'Collection,'* we find that the Arabs extended their commerce southward along the eastern coast of Africa, beyond Sofala, to above 20° of south latitude.

Such a remarkable man as this is surely not to be dismissed as an ignominious impostor. I yet hope that some one, more competent than myself, will do for his whole book what Yule has so well done for Marco Polo.

It is a pity that our author felt it necessary to bolster up the theory, then thought orthodox, that Jerusalem occupied the centre and highest part of the world, considering that he has shown he knew better. This may have been a sop to the ecclesiastical authorities, and has a grotesque effect after reading the dissertation given above.

I cannot find any one between Maundevile and Columbus who maintained the sphericity of the Earth, and the possibility of its circumnavigation. He appears to have been acquainted with the old Greek geographers' work. He *may* also have had access to Friar Bacon's researches about the figure of the Earth. This latter wonderful man died about 1292–4, or over twenty years before the beginning of Maundevile's travels; but as Bacon was previously imprisoned for many years on account of his writings, they must have been difficult of access. Sir John's attempted correction of the ancients' determination of the size of the Earth is, I believe, his own.

A characteristic feature of this curious book is his habit of quotation from Scripture (not always correctly) of any text which he considers bears on his observations, or supports his conclusions.

A. W. Stiffe

* 'Collection of Voyages and Travels.' London. 1745.

MEETINGS OF THE ROYAL GEOGRAPHICAL SOCIETY, SESSION 1898-99.

Afternoon Technical Meeting, Friday, January 27, 1899, *at* 4 *p.m.*—Sir Clements Markham, K.C.B., President, in the Chair.

The Paper read was :—

"On the Sub-Oceanic Physical Features off the Coast of Western Europe, including France, Spain, and Portugal." By Prof. Edward Hull, LL.D., F.R.S., F.G.S.

Fourth Ordinary Meeting, January 23, 1899.—Sir Clements Markham, K.C.B., President, in the Chair.

Elections.—*Alexander Dick-Cunyngham; Thomas Richard Glyn; John James Willoughby Livett; Major Henry Steuart Lockhart-Ross (5th Lancashire Fusiliers); Frederick Vavasour McConnell; John Edward Moore; Samuel Perkes; Lieut. W. B. Phillips, R.N.E.; G. H. St. Hill; F. G. Snelson; John Loudon Strain, M.Inst.C.E.; R. Willis (H.M.B. Consular Service, China); George Wyndham, M.P. (Under-Secretary of State for War).*

The President: I may mention to the meeting that we welcome here this evening a most distinguished South American geographer in Don Francisco Moreno, whose work is well known in this country, and who has explored regions in Patagonia of which we previously knew nothing. He has come over here in connection with the arbitration which has been referred to our Queen, and we hope in the course of the session we may receive one if not two interesting papers from Don Francisco.

The Paper read was :—

"The Plan of the Earth and its Causes." By Dr. J. W. Gregory.

Fifth Ordinary Meeting, February 13, 1899.—Sir Clements Markham, K.C.B., President, in the Chair.

Elections.—*Edward Arnold; R. Corfield Bucknall; Henry Cæsar Childers; Frederick W. Christian, B.A.; James Frederick Cornish; James Francis Cunningham; James Grön; Edward Herdman; Robert Martin Holland; Thomas Loching Hughes; Homer Beza Hulbert; Lieut. Henry F. N. Jourdain (The Connaught Rangers); Sultan Mahomet Khan, Mir Munshi of Kabul, Afghanistan; Cyril L. C. Locke, M.A.; S. S. McFarlane, L.R.C.S., L.R.C.P.; Deodoro Moegle; Captain H. N. Roome (6th Bengal Cavalry); C. Rozenraad; Sir John Scott, K.C.M.G.; Colonel Frederick George Slade, C.B.; Rev. Theodore A. Teitelbaum; Herbert Maxwell Warne; Rev. J. P. Woodward, B.A.*

The President said: I think it will interest the meeting to know that we have received a very interesting letter from the second in command of Major Macdonald's expedition to Lake Rudolf, Captain Austin of the Royal Engineers. He appears to have followed up the whole west side of Lake Rudolf, taken careful observations, and ascertained that the lake is a good deal further to the north, about 20 or 30 miles, than was previously supposed. It shows us we may confidently look forward to valuable and correct maps of that little-known region, when Major Macdonald returns. I think I may also ask you to welcome back our friend Sir Martin Conway, who has made, in a few months, journeys and ascents which it would have taken most people a few years to accomplish. He has reached the summits of Illimani

and Aconcagua, has been nearly to the summit of Illampu, and got within a thousand feet of Mount Sarmiento, near the Magellan straits, a remarkable piece of work in such a short time. I will also ask you to welcome a distinguished professor from the university of Santiago de Chile, who has come here to assist the arbitrators to delimit the boundary between Chile and the Argentine republic. It will take some time and require great consideration, and I hope we may frequently have the pleasure of seeing Prof. Bertrand at our meetings here.

The Paper read was:—

"Exploration in the Canadian Rockies: a Search for Mount Hooker and Mount Brown." By Prof. Norman Collie, F.R.S.

GEOGRAPHICAL LITERATURE OF THE MONTH.

Additions to the Library.

By HUGH ROBERT MILL, D.Sc., *Librarian*, R.G.S.

THE following abbreviations of nouns and the adjectives derived from them are employed to indicate the source of articles from other publications. Geographical names are in each case written in full:—

A. = Academy, Academie, Akademie.
Ann. = Annals, Annales, Annalen.
B. = Bulletin, Bollettino, Boletim.
Com. = Commerce, Commercial.
C. Rd. = Comptes Rendus.
Erdk. = Erdkunde.
G. = Geography, Geographie, Geografia.
Ges. = Gesellschaft.
I. = Institute, Institution.
Iz. = Izvestiya.
J. = Journal.
M. = Mitteilungen.
Mag. = Magazine.
P. = Proceedings.
R. = Royal.
Rev. = Review, Revue, Revista.
S. = Society, Société, Selskab.
Sitzb. = Sitzungsbericht.
T. = Transactions.
V. = Verein.
Verh. = Verhandlungen.
W. = Wissenschaft, and compounds.
Z. = Zeitschrift.
Zap. = Zapiski.

On account of the ambiguity of the words *octavo*, *quarto*, etc., the size of books in the list below is denoted by the length and breadth of the cover in inches to the nearest half-inch. The size of the *Journal* is 10 × 6½.

A selection of the works in this list will be noticed elsewhere in the "Journal."

EUROPE.

Andorra. *Annuaire Club Alpin Français* **23**, 1896 (1897): 311-345. **Régnault.**

L'Andorre. Par M. Félix Régnault. *With Illustrations.*

A visit to Andorra in 1895. The paper includes a list of sixteen books and articles on Andorra.

Austria-Hungary.

Publicationen für die Internationale Erdmessung. Die Astronomisch-Geodätischen Arbeiten des k. und k. Militär-Geographischen Institutes in Wien. XII. Band. Astronomische Arbeiten. 4. Längenunterschied-Messungen Kronstadt—Budapest Sarajevo—Kronstadt, Sarajevo—Pola; Polhöhen- und Azimuth-Bestimmungen auf den Stationen: Bösig, Donnersberg und Jeschken. Herausgegeben vom k. und k. Militär-Geographischen Institute. Wien, 1898. Size 12 × 9½, pp. vi. and 278.

Basques. *Globus* **74** (1898): 333-340. **Karutz.**

Zur Ethnographie der Basken. Von Dr. Karutz. *With Illustrations.*

Critical remarks on some theories of the origin of the Basques, with descriptions of various carts, sledges, and implements, acquired by the author in the Basque districts of Spain and France for the Ethnographical museum in Lübeck.

Belgium—Bruges. *B.S.R. Belge G.* **22** (1898): 376-395. **Du Fief.**

Bruges et le nouveau canal maritime. Par M. J. Du Fief.

Belgium—Geology. **De Windt.**

Travaux du Laboratoire de Minéralogie et de Géologie de l'Université de Gand. Sur les relations lithologiques entre les roches considérées comme cambriennes des massifs de Rocroi, du Brabant et de Stavelot. Par Jean De Windt. Bruxelles, 1898. Size 12 × 9½, pp. 96. *Plates. Presented by the Author.*

Europe—Climate. *Z. Ges. Erdk. Berlin* **33** (1898): 183–200. **Meinardus.**

Der Zusammenhang des Winterklimas in Mittel- und Nordwest-Europa mit dem Golfstrom. Von Dr. Wilhelm Meinardus. *With Diagrams.*

A study of the climatic conditions of Europe during the exceptionally mild winter of 1897–98, and the exceptionally cold winter of 1880–81, with special reference to the distribution of atmospheric pressure and the movements of the Gulf Stream.

France. *Rev. Maritime* **132** (1897): 257–285. **Loir.**

La livraison de Toulon aux Anglais (1793). Par M. M. Loir.

France. *Annuaire Club Alpin Français* **23**, 1896 (1897): 137–188. **Nœtinger.**

La Suisse niçoise. Par M. Fernand Nœtinger. *With Illustrations.*

On the valley of the Vésubie and the surrounding country in the neighbourhood of Nice.

France. *Annuaire Club Alpin Français* **23**, 1896 (1897): 509–523. **Villars.**

Voyage de Grenoble à la Grande-Chartreuse, le 8 messidor an XII.: manuscrit inédit de Dominique Villars, avec un avant-propos de M. Paul Guillemin.

A mountain journey undertaken on June 27, 1804.

France—Mont Blanc. *C. Rd.* **127** (1898): 942–945. **Hansky.**

Sur la détermination de la pesanteur au sommet du mont Blanc, à Chamonix et à Meudon. Note de M. Hansky.

France—Pyrenees. *Annuaire Club Alpin Français* **23**, 1896 (1897): 227–270. **Belloc.**

Les sources de la Garonne, récits de courses et d'expériences. Par M. Émile Belloc. *With Illustrations.*

The author takes the Col de Bérét as "the official and rational source of the French Garonne."

France—Vivarais. **Bourdin**

Le Vivarais. Essai de Géographie Régionale. Par Louis Bourdin. Paris: F. Alcan, 1898. Size 10 × 6½, pp. 262. *Illustrations. Price* 5*s.*

Germany. *Naturw. Wochenschrift* **13** (1898): 541–548, 553–557. **Graebner**

Ueber die Bildung natürlicher Vegetations-formationen im Norddeutschen Flachlande. Von P. Graebner.

On the forests and other features of the botanical geography of the North German plain.

Germany—Black Forest Lakes. *Petermanns M.* **44** (1898): 241–251. **Halbfass.**

Zur Kenntnis der Seen des Schwarzwaldes. Von Dr. W. Halbfass. *With Map.*

Dr. Halbfass has sounded and described a number of small lakes in the Black Forest, of which he gives bathymetrical maps. See *ante*, p. 300.

Germany—Commercial Education. **Powell.**

Commercial Education in Germany. Foreign Office, Miscellaneous, No. 483, 1898. Size 10 × 6½, pp. 30. *Price* 2*d.*

This report points out that the improvement in commercial education in Germany has followed, and not preceded, the great development in German trade. It goes on to detail the subjects of instruction in German commercial schools, and gives a number of selected time-tables.

Italy—Piedmont. **Worsfold.**

The Valley of Light: Studies with pen and pencil in the Vaudois Valleys of Piedmont. By W Basil Worsfold. London: Macmillan & Co., 1899. Size 9½ × 6, pp. x. and 336. *Map and Illustrations. Price* 10*s. Presented by the Publishers.*

In the form of a series of letters to a lady written from various places in the Vaudois Valleys, the author gives a historical account of the great feat of arms by which the persecuted Waldenses made their way back to their native valleys at the end of the sixteenth century; the description of the events being associated with the actual scenes in which they occurred.

Mediterranean. *B.S.G. Lille* **30** (1898): 282–287. **Paillot.**

Voyage au pays des Croisés. Par M. R. Paillot. *With Illustrations.*

A cruise in the Eastern Mediterranean.

Russia—Lakes. **Anuchin.**

Lakes in the region of the sources of the Volga and Western Dwina. By D. I. Anuchin. [In Russian.] Moscow, 1898. Size 10½ × 7, pp. 56. *Maps and Illustrations. Presented by the Author.*

Russia—Novaya Zemlya. **Feilden.**

The Flowering Plants of Novaya Zemlya, etc. By Colonel H. W. Feilden. (Reprinted from the *Journal of Botany*, October to December, 1898.) Size 9 × 6, pp. 36. *Presented by the Author.*

Spain and France. *Annuaire Club Alpin Français* **23**, 1896 (1897): 368–413. **Martel.**

Sous Terre (Neuvième Campagne 1896) Cueva del Drach, à Majorque.—Scialets du Vercors. Chouruns du Dévoluy. Par M. E. A. Martel. *With Plans and Illustrations.*

Records of speleological research, most space being given to the Dragon Cave in Majorca, and briefer reports of the caves of Dauphiné.

United Kingdom—England. **Hyde.**

The Low Peak. By John Hyde. (From the *Gentleman's Magazine*, November, 1898.) Pp. 480–490.

United Kingdom—Ireland. *P.R. Irish A.* **5** (1898): 40–72. **Browne.**

The Ethnography of Clare Island and Inishturk, County of Mayo. By Charles R. Browne, M.D. *With Plate.*

A continuation of the careful anthropological measurements and study of the people of the west coast of Ireland; the people of Clare island appear to be the descendants of the people who lived on the island two or three hundred years ago, with little change or intermixture.

United Kingdom—Scotland. **Douglas.**

The Climbers' Camp at Coruisk. By W. Douglas. (From the *Scottish Mountaineering Club Journal*, January, 1898, pp. 1–16.) Size 9 × 6. *Map and Illustrations. Presented by the Author.*

This paper contains a map of the Coolins on the scale of 6 inches to 1 mile, with new data not included in the Ordnance Survey map, as well as some soundings in Loch Coruisk.

Western Europe—Coal. **Combes.**

A travers le Monde, Tour du Monde **4** (1898): 365–366.

Existe-t-il de la houille dans le Pas-de-Calais? Par M. Paul Combes.

The argument stated is that the coal-basins of South Wales, Bristol, Dover, the north of France, south of Belgium, Aix-la-Chapelle, and the Ruhr valley, are part of a continuous sheet of the coal-measures, although trial borings in the department of Pas-de-Calais has found only scattered and slight indications of underlying coal.

ASIA.

Asia—Bibliography.

Oriental Catalogues of New and Second-Hand Books on Sale by Kegan Paul, Trench, Trübner & Co., Limited.—No. vii. Books on the Languages and Dialects spoken in British India and Ceylon, viz. Comparative Philology, Polyglots, etc. (pp. 40); No. viii. Books on the Great Oriental Religions (pp. 44); No. ix. Books on the Natural History and Medical Science of the East, and on the Agriculture and Industries of the Tropics (pp. 56); No. x. Books on African Philology (pp. 32); No. xi. Books for the study of the Languages of the Moslem World (pp. 48). Size 8½ × 6. *Presented by Messrs. Paul, Trübner & Co.*

Central Asia. *Norske G. Selsk. Aarb.* **9** (1898): 12–40. **Hedin.**

Genom Centralasia af dr. Sven Hedin.

Central Asia—Moghuls. **Elias and Ross.**

A History of the Moghuls of Central Asia, being the Tarikh-i-Rashidi of Mirza Muhammad Haidar, Dughlát. An English Version Edited, with Commentary, Notes, and Map by N. Elias. The Translation by E Denison Ross. Re-issue with Portrait and Map. London: Low & Co., 1898. Size 9 × 6, pp. xxvi. and 536. *Price* 10*s.* 6*d. Presented by the Publishers.*

This is a re-issue with a coloured frontispiece from a portrait of Timur, and a map of Central Asia, showing the region the war-like history of which forms the subject of the book.

China. ——

Chambre de Commerce de Lyon. La Mission Lyonnaise d'exploration commerciale en Chine, 1895–1897. Lyon: A. Rey et Cie., 1898. Size 12 × 8½, pp. xxxvi., 386, and 470. *Maps and Illustrations. Presented by the Chamber of Commerce, Lyons.*

This splendid monument of French commercial enterprise contains a history of the commission sent out by the Chamber of Commerce of Lyons to China, an account of the journeys made from Tongking to Sechuan and thence to Canton, an article on the aboriginal races of South-Western China, and a series of special commercial reports on Tongking, Yunnan, Hongkong, Canton, Kwechau, Sechuan, and Hankau, together with separate reports on the chief commodities of China, completes the work.

China. *Oester. Monats. Orient* **24** (1898): 123–129. ——

Die Seidencultur in China.

China. **Bray.**

Fd. de Bray. La Chine et ses besoins au point de vue de l'utilisation des Belges, de leurs capitaux et de leur industrie. Louvain: Polleunis & Centerick, 1898. Size 9½ × 6½, pp. xvi. and 60. *Map. Price* 1*s.* 6*d.*

The map shows a scheme for a railway system for China.

China. *Imp. and Asiatic Quarterly Rev.* **7** (1899): 58–63. **Little.**

The Partition of China. By Archibald Little.

China. *Scottish G. Mag.* **14** (1898): 643–648. **Yate.**

The Journey from Shanghai to Peking and back. By Major A. C. Yate. *With Illustrations.*

This contains useful notes on the route to Peking by the railway from Tientsin, with hints for improving the passenger service of the steamers.

Chinese Empire—Mongolia. *Globus* **74** (1898): 319–322. **Zichy.**

Aus Urga in der Mongolei. Von Eugen Graf Zichy. *With Illustrations.*

The illustrations contain some striking Mongolian portraits, illustrating the national dress.

French Indo-China. *Annuaire Club Alpin Français* **23**, 1896 (1897): 446–495. **Salles.**

Une tournée en Indo-Chine, novembre 1895—Mai 1896. Par M. A. Salles. *With Illustrations.*

A journey from Saigon to Langson.

India—Chitral. **Duthie.**

The Botany of the Chitral Relief Expedition, 1895. By J. F. Duthie.—Records of the Botanical Survey of India. Volume i., No. 9. Calcutta, 1898. Size 10 × 6½, pp. 139–182. *Map.*

India—Himalayas. **Waddell.**

Among the Himalayas. By Major L. A. Waddell. London: A. Constable & Co., 1899. Size 9½ × 6½, pp. xvi. and 452. *Map and Illustrations. Price* 18*s. Presented by the Publishers.*

The richly illustrated narrative of a journey through Sikkim by an accomplished student of the Himalayan peoples.

Indo-China. *Ann. G.* **7** (1898): 457–462. ——

Travaux du Bureau topographique des troupes de l'Indo-Chine.

Malay Archipelago. ——

Revised Supplement, 1898, relating to the Eastern Archipelago. Part i., 1890. (Corrected to October 17, 1898.) London: J. D. Potter, 1898. Size 10 × 6, pp. 84. *Price* 9*d. Presented by the Hydrographic Office, Admiralty.*

Pamir Boundary Commission. **Gerard, Holdich, Wahab, and Alcock.**

Report on the Proceedings of the Pamir Boundary Commission. By Major-General M. G. Gerard, C.B., Colonel T. H. Holdich, C.B., Lieut.-Colonel R. A. Wahab, and Surgeon-Captain A. W. Alcock, 1896. Calcutta, 1897. Size 13½ × 9, pp. 100. *Maps and Illustrations. Presented by the India Office.*

This very interesting and finely illustrated Report was noticed in the *Journal* for January, p. 50.

Philippine Islands. **Worcester.**

The Philippine Islands and their People. A Record of Personal Observation and Experience, with a short summary of the more important facts in the History of the Archipelago. By Dean C. Worcester. New York: The Macmillan Co., 1898. Size 10 × 6½, pp. xx. and 530. *Maps and Illustrations. Price* 15*s*. *Presented by the Publishers.*

This will for a long time be the standard work on the Philippine islands. Mr. Dean had spent nearly a year in the islands in 1887–88, studying their zoology, and especially their bird-life, and, returning in 1890, spent a much longer time in visiting and studying the various islands. The zoological motives of the author in no way lead him to neglect the historical, geographical, economic, and social aspects of the archipelago, which since his journeys has become an American possession.

Russia—Caucasus, etc. **Zichy**

XV. u. XVI. Jahresb. (1896 *u.* 1897) *Württemberg. Ver. Handelsg.* (1898): 22–35.

Meine Reise im Kaukasus und Zentralasien zur Ermittelung der Ursitze der Völker mit besonderem Bezug auf den ungarischen Namen. Von Eugen Graf Zichy.

Russia—Siberia. *Ann. G.* **7** (1898): 351–362, 429–440. **Raveneau.**

Louis Raveneau. Travaux des Russes dans l'Asie Septentrionale. *Also separate copy. Presented by the Author.*

Russia—Trans-Caspian. **Boutroue.**

Annuaire Club Alpin Français **23**, 1896 (1897): 414–445.

En Transcaspie. Par M. Alexandre Boutroue. *With Map and Illustrations.*

Russia—Trans-Caspian. *Petermanns M.* **44** (1898): 204–214. **Walther.**

Das Oxusproblem in historischer und geologischer Beleuchtung. Von Prof. Dr. Johannes Walther. *With Profile.*

Siam—Name. *Imp. and Asiatic Quarterly Rev.* 7 (1899): 162–164. **Gerini.**

Shan and Siam (A Few More Explanations). By Major G. E. Gerini.

Turkey. **Warkworth.**

Notes from a Diary in Asiatic Turkey. By Lord Warkworth, M.P. London: E. Arnold, 1898. Size 10 × 7½, pp. xvi. and 268. *Map and Illustrations. Price* 21*s*. *Presented by the Publisher.*

Lord Warkworth, now Earl Percy, has produced a superb record of his tour in Anatolia and Armenia, which took place in 1897–98. The book deals with the land and people from the standpoint of an English member of parliament, and is illustrated by a map of the route, and many beautifully reproduced and characteristic photographs. The journey was by rail from Scutari to Angora, thence to Samsun, by sea to Trebizond, and again by land to Erzerum, east to Alexandropol, and south by Bayazid and Van to Mosul, and thence through Diarbekir to Alexandretto.

AFRICA.

Algeria—Aurès Mountains. **Salomé.**

Annuaire Club Alpin Française **23**, 1896 (1897): 577–585.

Une ascension dans l'Aurès: l'Amar-Kaddou. Par M. Th. Salomé.

These mountains rise to the east of Biskra.

Algeria, Kabylia. *Annuaire Club Alpine Français*, **24** (1897) (1898): 297–331. **Tabary.**

Huit jours en Kabylie, flanc Nord du Djurjura. Le Tamgout de Lalla Khedidja. Par M. C. Tabary. *With Illustrations.*

Angola. *B.S. d'Études colon.* **5** (1898): 233–269. **Ivens.**

L'Angola méridional. Par Ch. Ivens.

An account of the country and the resources of southern Angola by a former Belgian Consul at Mossamedes.

Angola. *Kolonial Jahrb.* **11** (1898): 15–32. **Löser.**

Angola unter portugiesischer Herrschaft. Von Reinhard Löser.

A pessimistic account of the condition of Portuguese West Africa.

British Central Africa. ———

Africa, No. 9 (1898). Annual Report on the British Central Africa Protectorate for the year 1897–98. London: Eyre & Spottiswoode, 1898. Size 13½ × 8½, pp. 30. *Price* 3*d*.

British East Africa. *M.G. Ges. Wien* **41** (1898): 531–534. **Paulitschke.**

Begleitwort zur Karte der Graf Eduard Wickenburg's Reiserouten in Britisch-Ost-Afrika 1897 und 1898. Von Prof. Dr. Ph. Paulitschke. *With Map.*

British East Africa—Uganda. *Norske G. Selsk. Aarb.* **9** (1898): 168–195. **Skattum.**

Nilens kilder af skolebestyrer. C. J. Skattum.

A discussion of the history of the search for the sources of the Nile from the earliest times to the present.

British West Africa—Gold Coast. **Smith.**

Gold Coast. Annual Report for 1897. Colonial Reports, Annual No. 249, 1898. Size 10 × 6½, pp. 28. *Price* 2*d.*

This report contains the monthly rainfall for six stations.

British West Africa—Sierra Leone. **Edwards.**

The French and Sierra Leone. By F. A. Edwards. (From the *Gentleman's Magazine*, November, 1898, pp. 449–469.) *Map. Presented by the Author.*

Canary Islands—Teneriffe. **De Windt.**

Morphométrie de Ténériffe. Par Jean De Windt. Bruxelles, 1898. Size 9 × 6, pp. [10]. *Map. Presented by the Author.*

Measurements of the mean height and average slope of Tenerife from a contoured map.

Central Africa—Tanganyika. *Fortnightly Rev.* **65** (1899): 25–33. **Decle.**

The Tanganyika Railway. By Lionel Decle.

Congo State. **Cornet.**

L'age de la Pierre dans le Congo occidental. Communication faite à la Société d'Anthropologie de Bruxelles, dans la séance du 30 novembre 1896. Par M. J. Cornet.—Extrait du Bulletin de la Société d'Anthropologie de Bruxelles. Tome xv., 1896-1897. Bruxelles, 1897. Size 10 × 6½, pp. 8. *Plates. Presented by the Author.*

Description of palæolithic implements from the Congo State.

Congo State. *Norske G. Selsk. Aarb.* **9** (1898): 41–55. **Sundt.**

Fra Kongo. Af Kaptein Fr. Sundt.

Congo State. **Thonner.**

Im Afrikanischen Urwald. Meine Reise nach dem Kongo und der Mongalla im Jahre 1896. Von Franz Thonner. Berlin: D. Reimer (Ernst Vohsen), 1898. Size 10½ × 7, pp. x. and 116. *Portrait, Maps, and Illustrations. Price* 10*s.* 6*d.*

This record of a journey up the Mongallo river is illustrated by a fine set of 86 full-page photographs and three maps.

Congo State. *Ann. G.* **7** (1898): 462–466. **Lorin.**

Le chemin de fer du Congo. Par M. Henri Lorin.

Congo State. *Mouvement G.* **15** (1898): 586–589. **Wauters.**

Notre carte de l'État Independant du Congo au 2,000,000e. Feuille X: La région des Sources du Congo, le Katanga et le bassin du Bangweolo. Par A. J. Wauters. *With Map.*

East Africa—Bòttego's Second Expedition. **Vannutelli and Citerni.**
B.S.G. Italiana **10** (1897): 320–330.

Relazione preliminare sui risultati geografici della seconda spedizione condotta dal capitano Vittorio Bòttego nell' Africa orientale di L. Vannutelli e C. Citerni. *With Map.*

Egyptian Sudan. *B. Comité l'Afrique Française* 8 (1898): 367–370. ———

Dans le Bahr-el-Ghazal: L'occupation de Dem-Ziber.

This paper is illustrated by a facsimile of General Gordon's manuscript map.

French Guinea. *A travers le Monde, Tour du Monde* **4** (1898): 369–372. **Piquerez.**

La Guinée Française. Par M. Charles Piquerez. *With Illustrations.*

French Guinea. *Annuaire Club Alpin Français* **23**, 1896 (1897): 496–506. **Salesses.**

Une ascension au Kakoulima, Guinée française. Par M. le capitaine E. Salesses. *With Map.*

The mountain, which rises on the coast of French Guinea, north-west of Konakry, was ascended to the height of about 3000 feet, its total height being estimated at about 3400 feet.

French West Africa. **Castellani.**

Ch. Castellani. Vers le Nil Français avec la Mission Marchand. Paris: E. Flammarion [1898]. Size 9 × 6, pp. 438. *Illustrations. Price* 8*s.* 6*d.*

Description by an artist of the first stage of the Marchand expedition on the Mobangi.

German South-West Africa. **Rehbock.**

Deutsch-Südwest-Afrika. Seine wirtschaftliche Erschliessung unter besonderer Berücksichtigung der Nutzbarmachung des Wassers. Bericht über das Ergebnis einer im Auftrage des "Syndikates für Bewässerungsanlagen in Deutsch-Südwest-Afrika" durch das Herero- und Gross-Namaland unternommenen Reise von Th. Rehbock. Berlin: D. Reimer (Ernst Vohsen), 1898. Size 11 × 7½, pp. xxii. and 238. *Maps and Illustrations. Price* 14*s. Presented by the Publisher.*

The author went out to German South-West Africa on behalf of a syndicate for establishing irrigation works. He describes his expeditions in Hereroland and Namaland, discusses the existing geographical and economic conditions, and deals in great detail with the question of water-supply and irrigation.

German West Africa—Kamerun. **Plehn.**

Die Kamerun-Küste. Studien zur Klimatologie, Physiologie und Pathologie in den Tropen. Von Dr. Friedrich Plehn. Berlin: A. Hirschwald, 1898. Size 10 × 6½, pp. vi. and 364. *Map and Diagrams.*

On the hygienic conditions of the Kamerun coast considered in relation to climate and specific diseases.

Mauritius. **Bruce.**

Mauritius and Rodrigues. Annual Reports for 1897. Colonial Reports, Annual No. 250, 1898. Size 10 × 6½, pp. 42. *Price* 2½*d.*

Portuguese East Africa—Limpopo. *B.S.G. Lisboa* **16** (1897): 561–568. ——

Esboço hydrographico do Limpopo. Memoria descriptiva. *With Map.*

The map is on a very large scale, and shows the soundings of the river Limpopo taken by an armed launch.

Sokotra. *Scottish G. Mag.* **14** (1898): 629–636. **Bent.**

The Island of Sokotra. By Mrs. Theodore Bent.

A paper read at the meeting of the British Association at Bristol.

Somaliland. *B.S.G. Italiana* **10** (1897): 257–264, 309–313. ——

Comunicazioni della Presidenza. Spedizione Bòttego.

Sudan. *B. Comité l'Afrique Française* **8** (1898): 363–367. ——

La mission Marchand.

Sudan. *B. Comité l'Afrique Française* **8** (1898): 325–332. **Liotard and Marchand.**

De l'Oubangui au Nil: Les missions Liotard et Marchand.

Sudan. **Edwards.**

How the Sudan was conquered. By F. A. Edwards. (From the *Westminster Review*, December, 1898, pp. 609–617.) Size 10 × 6½. *Presented by the Author.*

West Africa. *Petermanns M.* **44** (1898): 193–204. **Frobenius.**

Der westafrikanische Kulturkreis. Von L. Frobenius. *With Maps.*

NORTH AMERICA.

Canada—Ethnological Survey. ——

An Ethnological Survey of Canada.—Second Report of the Committee. Size 8½ × 5½, pp. 18. *Presented by C. Hill-Tout, Esq.*

Mexico. *P.A. Nat. Sci. Philadelphia* (1898): 372–413. **Harshberger.**

Botanical Observations on the Mexican Flora, especially on the Flora of the Valley of Mexico. By John W. Harshberger, PH.D.

Newfoundland. *Nineteenth Century* **45** (1899): 46–55. **McGrath.**

France in Newfoundland. By P. T. McGrath.

Niagara Falls. *American J. Sci.* **6** (1898): 439–450. **Spencer.**

Another Episode in the History of Niagara Falls. By J. W. Spencer. *With Map and Section.*

United States—Arizona. **Franklin.**

Report of the Governor of Arizona.—Annual Report of the Secretary of the Interior, 1896. Vol. iii. pp. 207–346. *Map and Illustrations.*

An elaborate and well-illustrated description of the territory of Arizona.

United States—Hydrographic Office. *Nautical Mag.* **67** (1898): 414–423. **Allingham.**

The United States Hydrographic Office. By W. Allingham.

United States—Minnesota. *American J. Sci.* **6** (1898): 469–477. **Todd.**

A Revision of the Moraines of Minnesota. By J. E. Todd. *With Map.*

United States—Missouri and South Dakota. **Owen.**

Cave Regions of the Ozarks and Black Hills. By Luella Agnes Owen. Cincinnati: The Editor Publishing Co., 1898. Size 7½ × 5½, pp. 228. *Plans and Illustrations. Presented by the Publishers.*

An interesting account of the great caverns of South Dakota and Missouri, with striking photographs of the stalactitic chambers.

United States—New Mexico. **Thornton.**

Report of the Governor of New Mexico.—Annual Report of the Secretary of the Interior, 1896. Vol. iii. pp. 347–419.

United States—Kansas. *T.A. Sci. St. Louis* **8** (1898): 55–70. **Hitchcock.**

Ecological Plant Geography of Kansas. By A. S. Hitchcock.

The word *Ecological* is not explained. The plants are considered with regard to habitat—*e.g.* water, swamps, desert, rocks, etc.

CENTRAL AND SOUTH AMERICA.

Argentine and Chile. **Varela.**

Luis V. Varela. En la Cordillera Andina. Contribución al estudio histórico-juridico de los tratados y protocolos celebrados entre la República Argentina y Chile, 1843-1898. Seguido de un Apéndice con el texto integro de los tratados, protocolos y actas correspondientes. Buenos Aires, 1898. Size 8 × 5½, pp. 150. *Presented by the Author.*

Argentine Republic. **Figueroa.**

Ministerio de obras Publicas de la Provincia de Buenos Aires. Estudios sobre Puertos en la Provincia de Buenos Aires. Primera Parte. La Costa Maritima. Informe presentado al Departamento de Ingenieros por el Jefe de la Comisión Encargada de los Estudios Ing°. Julio B. Figueroa. Text and Atlas. La Plata, 1897. Size (Text) 11½ × 7½, (Atlas) 14½ × 11½, pp. liv. and 400. *Presented by the Author.*

Brazil—Bahia. *Rev. Trim. I. G. e Hist. Bahia* **5** (1898): 437–450. **Souza.**

As Riquezas naturaes do Estado da Bahia, pelo Capitão-tenente Collatino Marques de Souza.

On the natural resources of the State of Bahia.

Chile. *M.G. Ges. Jena* **17** (1898): 1–23. **Martin.**

Der Calbuco und andere Vulkane des südlichen Chile. Von Dr. Carl Martin.

Chile—Western Patagonia. **Steffen.**

Viajes i Estudios en la rejion hidrográfica del Rio Puelo (Patagonia Occidental). Por Dr. Juan Steffen. Santiago de Chile: Imp. Cervantes, 1898. Size 9½ × 6½, pp. 176. *Maps and Illustrations. Presented by the Author.*

Dr. Steffen's description of the Chilian survey expedition to the region of the Argentine boundary is followed by three appendices—on the botanical geography of the Rio Manso region, by Dr. Krüger; the petrology of the rocks collected during the expedition, by Dr. Pöhlmann; and the observations of latitude and altitude made by Dr. Krüger.

Cuba—Archæology. **Brinton.**

The Archæology of Cuba. By Daniel G. Brinton, M.D. (Reprinted from *American Archæologist*, Columbus, O., vol. 2, No. 10, October, 1898.) Size 9½ × 6½, pp. 4. *Presented by the Author.*

Falkland Islands—Marine Fauna. **Pratt.**

Mem. and P. Manchester Lit. and Philosoph. S. **42** (1898): 1–26.

Contributions to our Knowledge of the Marine Fauna of the Falkland Islands. By Edith M. Pratt. *With Plate.*

Peru—Railways. **Figueroa.**

Julio B. Figueroa. La vía interoceánica central del Perú. (Artículo publicado en los "Anales de la Sociedad Cientifica Argentina," tomo xlv., páginas 209 y siguientes.) Buenos Aires, 1898. Size 10 × 6½, pp. 30. *Profile. Presented by the Author.*

On the projected trans-Andine railway to connect Callao *viâ* Oroya with the navigable tributaries of the Amazon.

Trinidad. **Stark.**

Stark's Guide-Book and History of Trinidad, including Tobago, Granada, and St. Vincent; also a trip up the Orinoco, and a description of the great Venezuelan Pitch Lake, containing a description of everything relating to these places that would be of interest to Tourists and Residents. By James H. Stark. Boston: J. H. Stark; London: Low & Co. 1897. Size 8 × 5½, pp. x. and 170. *Maps and Illustrations. Price* 6*s.*

West Indies. **Hill.**

Cuba and Porto Rico, with the other Islands of the West Indies. Their Topography, Climate, Flora, Products, Industries, Cities, People, Political Conditions, etc. By Robert T. Hill. London: T. Fisher Unwin, 1898. Size 9½ × 6½, pp. xxviii. and 430. *Maps and Illustrations. Price* 16*s. Presented by the Publisher.*

This is a solid and valuable contribution to the scientific knowledge of the West Indies, dealing first with the geography and natural conditions of the West Indies as a whole, and then discussing each of the larger islands in detail. While the special interest of the book at present lies in the description of the rich islands occupied by the United States army, the other members of the archipelago are also adequately and authoritatively described.

AUSTRALASIA AND PACIFIC ISLANDS.

Australasia. **Semon.**

In the Australian Bush and on the Coast of the Coral Sea. Being the experiences and observations of a Naturalist in Australia, New Guinea, and the Moluccas. By Richard Semon. London: Macmillan & Co., 1899. Size 10½ × 7, pp. xvi. and 552. *Maps and Illustrations. Price* 21*s. Presented by the Publishers.*

The admirable character of Prof. Semon's popular account of his travels and study of the natural history of Australasia was pointed out when noticing the German edition, and it is satisfactory to find that this interesting work has been presented in an English dress.

Australasia—Tide-tables. **Goalen.**

Tables for finding approximately the Time and Height of High Water at the principal ports in New Zealand (Auckland, Wellington, Lyttleton, Port Chalmers); also at Sydney, New South Wales, and Hobart, Tasmania. By Captain W. N. Goalen. London: J. D. Potter, 1898. Size 10 × 6½, pp. 24. *Price* 8*d.*

Australian Aborigines. **Spencer and Gillen.**

The Native Tribes of Central Australia. By Baldwin Spencer, M.A., and F. J. Gillen. London: Macmillan & Co., 1899. Size 9½ × 6, pp. xx. and 672. *Maps and Illustrations. Price* 21*s. Presented by the Publishers.*

This is an exhaustive anthropological treatise illustrated by photographs of the various rites and implements described. Mr. Gillen, as the "special magistrate and sub-protector of aborigines" at Alice Springs in South Australia, was for nearly twenty years closely concerned with native tribes, and both authors are regarded as fully initiated members of one of the tribes. The complex questions of native relationships and the totemic system are gone into more fully and with more perfect data than ever before, and due care is taken to keep separate the record of observed facts and the theoretical conclusions to which their discussion tends. Two maps are given, showing the tracks and camping-places of two of the Central Australian tribes.

British Solomon Islands. **Woodford.**

British Solomon Islands. Annual Report for 1897–8. Colonial Reports, Annual No. 251, 1898. Size 10 × 6½, pp. 16. *Price* 1*d.*

German New Guinea. *Kolon. Jahrb.* **11** (1898): 1–14. **Dempwolff.**

Die Erziehung der Papuas zu Arbeitern. Von Dr. Otto Dempwolff.

On the people of German New Guinea, and the way in which they may best be trained to work.

German New Guinea. *Petermanns M.* **44** (1898); 275–276. **Langhans.**

Beiträge zur Kenntnis der deutschen Schutzgebiete. Von Paul Langhans. Nr. 12A: Karawarra in der Neu-Lauenburg-Gruppe. Nr. 12B: Enüwetok oder Brown-Inseln. *With Maps.*

Hawaii. *P.A. Nat. Sci. Philadelphia* (1898): 203–205. **Sharp.**

Rock Inscriptions in Kauai, Hawaiian Islands. By Dr. Benjamin Sharp.

New South Wales. ———

Annual Report of the Department of Mines and Agriculture, New South Wales, for the year 1897. Sydney, 1898. Size 13 × 8½, pp. 216. *Plans.*

New South Wales. ———

New South Wales. Report of the Department of Public Works, for the year ended 30th June, 1897. Sydney, 1898. Size 13½ × 8½, pp. 118. *Maps and Illustrations. Presented by the Agent-General for New South Wales.*

Reports and maps of the railways, roads, harbour-improvements and other public works of the colony, including a large-scale map of the sewerage of Sydney.

New South Wales. ———

New South Wales. Eighteenth Annual Report of the Department of Lands, being for the year 1897. Sydney, 1898. Size 13 × 8½, pp. iv. and 120. *Maps. Presented by the Agent-General for New South Wales.*

With numerous maps showing the transactions in public lands, the position of the great lines of rabbit-proof fencing in New South Wales, and other matters. (See p. 307.)

New Zealand. **Kronecker.**

Wanderungen in den Südlichen Alpen Neu-Seelands mit zahlreichen nach original Photographien hergestellten Abbildungen von Dr. med. Franz Kronecker. Berlin: Max Pasch, 1898. Size 10 × 6½, pp. 120. *Map and Illustrations. Presented by the Author.*

Record of a mountaineering trip in New Zealand, by a member of the German Alpine Club.

New Zealand. **Reeves.**

The Long White Cloud. Ao Tea Roa. By William Pember Reeves. London: Horace Marshall & Son, 1898. Size 8½ × 6, pp. xiv. and 430. *Map and Illustrations. Price* 6*s. Presented by the Publishers.*

The Agent-General for New Zealand has here produced an attractive history of the colony he represents, in which the characteristics of Maori and colonist are sympathetically treated as a clue to the incidents of the early troubles and present prosperity of the islands.

Polynesia. *Globus* **74** (1898): 313–315. **Thilenius.**

Nordwest-Polynesier. Von Dr. G. Thilenius.

The article includes an account of a landing on Stewart island in 8° 24′ S. and 163° 2′ E., and a comparison between the people and language of the atoll with those of other Polynesian groups. The author comments on the confusion caused by the number of islands to which the names of Stewart, Lord Howe, Sandwich, etc., are applied in the Pacific.

Queensland. **Jack.**

Queensland Department of Mines, Geological Survey. Bulletin No. 9. Report to the Honourable the Minister for Mines on the Chillagoe Mining District and Projected Railway. By Robert L. Jack. Brisbane, 1898. Size 9 × 6, pp. 22. *Map. Presented by the Author.*

Samoa. *Fortnightly Rev.* **65** (1899): 54–73. **Leigh.**

The Powers and Samoa. By John George Leigh.

South Australia. *Deutsche G. Blätter* **21** (1898): 162–166. **Greffrath.**

Das australische Nordterritorium. Von Henry Greffrath.

Western Australia. **Carnegie.**

Spinifex and Sand. A Narrative of Five Years' Pioneering and Exploration in Western Australia. By the Hon. David W. Carnegie. London: C. Arthur Pearson, Limited, 1898. Size 9 × 6, pp. xvi. and 454. *Portrait, Maps, and Illustrations. Price* 21*s. Presented by the Publisher.*

A full narrative of the author's travels for five years on the gold-fields and in the far interior of Western Australia, illustrated by good maps and interesting photographs

and sketches. The geographical results were summarised in the paper read by Mr. Carnegie to the Royal Geographical Society, and published in the *Journal*, vol. xi. p. 258.

Western Australia. *J. R. Colonial I.* **30** (1898): 9–29. **Wittenoom.**

Western Australia in 1898. By the Hon. E. H. Wittenoom.

The article deals with climate, land, goldfields and general resources. Attention is called to the fact that a steamer of 10,000 tons recently entered Fremantle harbour, which is being deepened to render it available for easy use by the largest passenger vessels.

Western Australia—Year-Book. **Fraser.**

Western Australian Year-Book for 1896–97. (Tenth Edition.) By Malcolm A. C. Fraser. Perth, 1898. Size 8½ × 5½, pp. xvi. and 580. *Maps. Presented by the Registrar-General of Western Australia.*

Another copy. *Presented by the Author.*

POLAR REGIONS.

Antarctic. *Norske G. Selsk Aarb.* **9** (1898): 153–156. **Borchgrevink.**

Den antarctiske expedition (uddrag) af C. E. Borchgrevink.

The plan of the cruise of the Southern Cross.

Antarctic. *Nautical Mag.* **67** (1898): 833–836. **Caborne.**

Antarctic Exploration. By Commander W. F. Caborne.

Antarctic. *Riv. G. Italiana*, **5** (1898): 519–532. **Gribaudi.**

Verso il Polo Sud del Dottor Pietro Gribaudi.

A summary of recent projects for antarctic exploration.

Arctic—Spitsbergen. *Ymer* **18** (1898): 235–242. **Nathorst.**

Om Spaningarne efter Andrée kring Spetsbergen och vid Franz Josefs Land. Af A. G. Nathorst.

On the voyage in search of traces of Andrée round Spitsbergen and to Franz Josef Land.

MATHEMATICAL GEOGRAPHY.

Determination of Heights. *Riv. G. Italiana* **5** (1898): 457–464. **Bittanti.**

La determinazione delle altitudini presso gli antichi di Ernesta Bittanti.

On the methods of finding heights used in ancient times.

Geodesy. *Science* **8** (1898): 841–847. **Preston.**

The General Conference of the International Geodetic Association at Stuttgart, October 3–12, 1898. By E. D. Preston.

Great Globe. *Deutsche G. Blätter* **21** (1898): 151–161. **Reclus.**

Ein grosser Globus. Vortrag von Prof. Elisée Reclus.

Longitude Determinations. *C.Rd.* **127** (1898): 935–938. **Bigourdan.**

Sur la prédiction des occultations d'étoiles par la Lune, et sur le calcul des longitudes terrestres au moyen des occultations. Mémoire de M. G. Bigourdan.

Latitude. *C. Rd.* **127** (1898): 801–804. **Renan, Perchot, and Ebert.**

Sur la détermination de la latitude de l'Observatoire de Paris, par les méthodes de M. Lœwy. Note de MM. H. Renan, J. Perchot, et W. Ébert.

M. Lœwy's method is to observe a star very near the pole in nearly symmetrical positions with regard to the hour circles of 6h. or 18h., and overcoming the want of perfect symmetry by a calculation derived by a simple formula from two observed instrumental co-ordinates.

Map Projections. *Riv. G. Italiana* **5** (1898): 437–456, 501–518. **Venturi.**

Sopra alcune proprietà rappresentative degli angoli e sulla proiezione isodromica. Nota del Prof. A. Venturi.

Nautical Tables.

Navigation Tables. Published by the Chief of the Hydrographic Department, Ministry of Marine, 1897. 7th edition. [In Russian.] St. Petersburg, 1897. Size 10 × 6½, pp. 134 and 342.

Navigation. *Nautical Mag.* **67** (1898): 188–192. **Johnson.**

Great Circle Sailing made easy. By A. C. Johnson.

Surveying. **Blim and Rollet de l'Isle.**

Manuel de l'Explorateur, procédés de levers rapides et de détail; détermination astronomique des positions géographiques. Par E. Blim et M. Rollet de l'Isle. Paris: Gauthier-Villars, 1899 [1898]. Size 7¼ × 5, pp. viii. and 260.

Instructions in surveying for travellers.

Tides. *National G. Mag.* **9** (1898): 465–475. **Jefferson.**

What is the Tide of the open Atlantic? By Mark S. W. Jefferson.

Tides. *J.R. United Service I.* **42** (1898): 1378–1413. **Moxly.**

A suggested correction of the accepted theory of the Tides. By the Rev. J. H. S. Moxly.

PHYSICAL AND BIOLOGICAL GEOGRAPHY.

Geology. **Marr.**

The Principles of Stratigraphical Geology. By J. E. Marr. Cambridge: The University Press, 1898. Size 7¼ × 5, pp. 304. *Illustrations. Price* 6*s. Presented by the Publishers.*

A remarkably clear exposition of the essential facts of stratigraphical geology without the use of technical language. This is exactly the sort of book for a student of physical geography to study, in order to obtain a working knowledge of the order of the rocks and the meaning and value of geological maps.

Geomorphology. *Scottish G. Mag.* **14** (1898): 649–654. **Suess.**

On the Asymmetry of the Northern Hemisphere.

A summary of a lecture by Prof. Suess, in which he calls attention to many interesting and puzzling features in the terrestrial relief of the northern hemisphere.

Geomorphology. **Geikie.**

Earth Sculpture, or the Origin of Land-Forms. By James Geikie, LL.D., etc. London: John Murray, 1898. Size 9 × 6, pp. xvi. and 320. *Illustrations. Price* 6*s. Presented by the Publisher.*

This is the first English book dealing systematically with the classification and origin of land-forms, epitomizing the contribution of geology to the science of geography. The classes of land-forms are arranged according to the arrangement of the strata, *i.e.* in regions of horizontal, gently inclined, folded, disturbed, or faulted strata, and with regard to igneous, glacial, and æolian and aqueous action. Chapters are devoted to basins, coast-lines, and to the classification of land-forms. A glossary of technical terms and an index adapt the book for ready reference. (See p. 308.)

Meteorology—Temperature. **Rubenson.**

K. Svensk. Vetens.-A. Handlingar **30** (1898): 1–85.

Études sur diverses méthodes servant à calculer la moyenne diurne de la température à l'aide des observations faites aux heures adoptées dans les stations météorologiques suédoises. Par R. Rubenson.

Oceanic Life. *K. Svensk. Vetens.-A. Handlingar* **30** (1898): 1–426. **Aurivillius.**

Vergleichende thiergeographische Untersuchungen über die Plankton-Fauna des Skageraks in den Jahren 1893–1897. Von Carl W. S. Aurivillius.

Oceanography. **De Windt.**

Sur les distances moyennes à la Côte dans les Océans. Par Jean de Windt. Bruxelles, 1898. Size 11½ × 9½, pp. 14. *Maps. Presented by the Author.*

A calculation of the positions of lines on the ocean surface equidistant from the nearest land.

Oceanography. *Scottish G. Mag.* **14** (1898): 636–642. **Natterer.**

Oceanographical Results of the Austro-Hungarian Deep-sea Expeditions. By Dr. K. Natterer.

A paper read at the Bristol meeting of the British Association.

Oceanography and Climate. *Ymer* **18** (1898): 243–253. **Pettersson.**

Om Atlantiska oceanens inflytande på vårt vinterklimat. II. Af Otto Petterson. *With Diagrams.*

On the influence of the Atlantic ocean on the winter climate of Sweden.

Oceanography—Temperature. *Petermanns M.* **44** (1898): 258–259. **Köppen.**

Temperatur-Anomalie der Meeresoberfläche. Nach Prof. Dr. W. Köppen. *With Map.*

The object of this map—which has already appeared in the *Annalen für Hydrographie*—is to show the regions where the temperature of the surface water is high or low, relatively to the normal temperature of the latitude.

Physical Geography. **Dawkins and Hobson.**

The Owens College, Manchester. Physical Geography Lectures, by Prof. Boyd Dawkins and Bernard Hobson. References to Literature of the Subject. Size 7½ × 5, pp. 24. *Presented by Bernard Hobson, Esq., M.Sc.*

A classified list of books and papers on the various departments of physical geography.

Phyto-Geography. *T.A. Sci. St. Louis* **8** (1898): 25–41. **Schrenk.**

The Trees of St. Louis as influenced by the Tornado of 1896. By Hermann von Schrenk. *With Plates.*

A study of the wood of trees killed or injured during the passage of a tornado.

River Development. **Russell.**

River Development as illustrated by the Rivers of North America. By Prof. I. C. Russell. London: John Murray, 1898. Size 8½ × 6, pp. xvi. and 328. *Illustrations. Price* 6*s. Presented by the Publisher.*

Valley-formation. *Ann. G.* **7** (1898): 385–403. **Martonne.**

Problèmes de l'histoire des vallées. Enns-Salzach. Par M. E. de Martonne.

This article deals with the geographical history of the valleys of the Enns-Salzach system as a contribution to the study of the relation of river-systems to the land.

ANTHROPOGEOGRAPHY AND HISTORICAL GEOGRAPHY.

Commercial Geography. **Cornewall-Jones.**

The British Merchant Service, being a History of the British Mercantile Marine from the Earliest Times to the Present Day. By R. J. Cornewall-Jones. London: Low & Co., 1898. Size 9 × 6, pp. xviii. and 406. *Illustrations. Presented by the Publishers.*

A history of British merchant shipping, with descriptions and pictures of all types of trading vessels from the earliest down to the present day, and additional chapters on lighthouses, light-ships, flags, and other matters affecting the mercantile marine.

Commercial Geography. *B.S.G. Lisboa* **16** (1897): 503–549. **Rozenraad.**

A lucta commercial das Nações. Conferencia realisada no Instituto dos Banqueiros de Londres em 2 de Fevereiro de 1898 por C. Rozenraad. Traducção do Inglez de M. da Motta.

Commercial Geography—Fibres. ———

Royal Gardens, Kew. Bulletin of Miscellaneous Information. Additional Series, II. Selected Papers from the Kew Bulletin. I.—Vegetable Fibres. London: Eyre & Spottiswoode, 1898. Size 9½ × 6, pp. 280. *Price* 3*s.* 6*d. Presented by the Director, Royal Gardens, Kew.*

A collection of eighty-nine articles dealing with a large number of different vegetable fibres produced in all parts of the world.

Historical—Vasco da Gama. *B.S.G. Lisboa* **16** (1897): 551–559. **Tomaschek.**

A viagem de Vasco da Gama (1497–1499). Conferencia do Professor Dr. Wilhelm Tomaschek na sessão solemne commemorativa em Vienna de Austria.

Historical—Vasco da Gama. ———

Cuarto Centenario del descubrimiento del camino marítimo para la India por Vasco de Gama. Mexico, 1898. Size 9 × 6½, pp. 70.

Historical—Vasco da Gama. *Norske G. Selsk. Aarb.* **9** (1898): 157–167. **Storm.**

Portugisernes opdagelse af søveien til Indien af Prof. Dr. Gustav Storm. *With Map and Portrait.*

Life at High Altitudes. **Mosso.**

Life of Man on the High Alps. By Angelo Mosso. Translated from the Second Edition of the Italian. By E. Lough Kiesow. London: T. Fisher Unwin, 1898. Size 10 × 6½, pp. xvi. and 342. *Illustrations. Price* 21*s. Presented by the Publisher.*

A record of the careful study of the physiological effects of exertion at high altitudes, carried out by Dr. Mosso on an extensive scale with the men of the Italian

regiment stationed on the Alpine frontier, with additional information from other quarters. The discussion is a solid contribution to the question of the action of the rarefied air at high altitudes on climbers.

BIOGRAPHY.

Biographical Dictionary. **Lee.**

Dictionary of National Biography. Edited by Sidney Lee. Vol. lvi. Teach—Tollet; vol. lvii., Tom—Tytler. London: Smith, Elder, & Co., 1898–99. Size 10 × 6¼, pp. (vol. lvi.) vi. and 454; (vol. lvii.) vi. and 462. *Price each vol.* 15*s.*

The following names of geographical interest appear among the notices in these volumes: Vol. lvi., Sir James Emerson Tennent, by G. C. Boase; Thomas Thompson, by E. Irving Carlyle; Sir Charles Wyville Thomson, by Rev. Prof. Bonney; Joseph Thomson, by H. A. Webster; Thomas Thomson, by B. B. Woodward; Robert Thorne, by C. Raymond Beazley; and Henry Timberlake, by Miss C. Fell Smith. Vol. lvii., William Towerson, by C. Raymond Beazley; Robert Townson, by E. Irving Carlyle; John Thomas Towson, by C. W. Sutton; James Kingston Tuckey, by Prof. J. K. Laughton; John Turnbull, by E. Irving Carlyle; and Samuel Turner, by Stephen Wheeler.

Chaix. **Kuhne.**

M. Paul Chaix. Par E. Kuhne. *With Portrait.* From *La Patrie Suisse*, No. 133. Genève, 26 Octobre, 1898. Pp. 253–254. Size 12 × 9.

Prof. Paul Chaix, a Corresponding Member of the Royal Geographical Society, has recently celebrated his ninetieth birthday amidst the congratulations of his fellow-geographers in Switzerland.

Fitzroy. *Symons's Monthly Meteorolog. Mag.* **33** (1898): 161–164. ——

Dealing mainly with Admiral Robert Fitzroy's services to meteorology.

GENERAL.

Almanac. ——

Annuaire pour l'An 1899, publié par le Bureau des Longitudes. Avec des Notices scientifiques. Paris: Gauthier-Villars. Size 6 × 4, pp. [772].

Almanac. **Olsen.**

The Fisherman's Nautical Almanack and Tide Tables. 1899. By O. T. Olsen. London: J. D. Potter. Size 7½ × 5, pp. 452. *Plan. Price* 1*s. Presented by the Compiler.*

Bibliography. ——

The English Catalogue of Books for 1897. London: Low & Co., 1898. Size 10 × 6½, pp. 236. *Price* 5*s.*

Bibliography. **Baschin.**

Bibliotheca Geographica, herausgegeben von der Gesellschaft für Erdkunde zu Berlin. Bearbeitet von Otto Baschin. Band IV. Jahrgang, 1895. Berlin: W. H. Kühl, 1898. Size 9 × 6, pp. xvi. and 412.

The volume for 1895 is even fuller and more satisfactory than its predecessors. A slight rectification in the arrangement, by which Commercial Geography is classed under Anthropogeography, is a distinct improvement. The accuracy of the printing of foreign titles is remarkable, and the exhaustiveness of the work leaves nothing to wish for.

British Empire. ——

Statistical Abstract for the several Colonial and other Possessions of the United Kingdom, in each year from 1883 to 1897. London: Eyre & Spottiswoode, 1898. Size 10 × 6½, pp. 300. *Price* 1*s.* 3*d.*

British Empire. ——

Colonial Import Duties. Return relating to the Rates of Import Duties levied upon the Produce and Manufactures of the United Kingdom, etc., in the Principal Colonial and other Possessions of the United Kingdom. London: Eyre & Spottiswoode, 1897. Size 10 × 6½, pp. viii. and 400. *Price* 1*s.* 8*d.*

Educational. ——

Education Department. Special Reports on Educational Subjects. Vols. 2 and 3. London: Eyre & Spottiswoode, 1898. Size 10 × 6½, pp. (vol. 2) viii. and 694; (vol. 3) vi. and 698. *Illustrations, Map, and Diagrams. Price* (vol. 2) 6*s.* 2*d.*; (vol. 3) 3*s.* 3*d.*

Although none of the articles deals specially with geography, several bear on its teaching, including descriptions of educational museums, and of the Royal Geographical Society's collection now in the keeping of the Teachers' Guild.

Educational—Methods. *Riv. G. Italiana* 5 (1898): 465–480. **Andreini.**

Sul materiale scolastico per l'insegnamento della Geografia e più specialmente sui plastici topografici. Considerazioni ed appunti del Dott. Angelo L. Andreini.

Health. *P.R.S.* 64 (1898): 100–118. **Kanthack, Durham, and Blanford.**

On Nagana, or Tsetse Fly Disease. (Report, made to the Tsetse Fly Committee of the Royal Society, of Observations and Experiments carried out from November, 1896, to August, 1898.) By A. A. Kanthack, H. E. Durham, and W. F. H. Blanford.

Ice Age. **Taber.**

The Ice Age, Past and Coming. By C. A. M. Taber. Boston: G. H. Ellis, 1898. Size 8 × 5¼, pp. 102. *Charts. Presented by the Author.*

The author, who for many years was a South Sea whaler, lays stress on the great importance of oceanic currents and the circulation to which they give rise in influencing the temperature of the Earth's surface. He attributes the coldness of deep oceanic water to indraughts from the antarctic regions, where refrigeration has room to have its full effect, on account of the westerly winds keeping up an east-to-west current round the world, and so cutting off direct tropical surface currents from the antarctic sea.

Indian Ocean. **Findlay.**

A Directory for the Navigation of the Indian Ocean, with descriptions of its Coasts, Islands, etc., from the Cape of Good Hope to the Strait of Sunda and Western Australia, including also the Red Sea and the Persian Gulf, the Winds, Monsoons, and Currents, and the Passages from Europe to its various ports. Fourth Edition (1882). With Addenda, 1897. By Alexander George Findlay. London: R. H. Laurie. Size 10 × 6½, pp. xxxviii. and 1304; Addenda, 170. *Charts, etc. Price* 28*s*. *Presented by the Publisher.*

The 170 pages of addenda take account of all important changes in the body of the work, the valuable character of which is so well known.

Meteorites. **Fletcher.**

British Museum (Natural History). Mineral Department. An Introduction to the Study of Meteorites, with a list of the Meteorites represented in the collection. By L. Fletcher. Printed by order of the Trustees, 1896. Size 8¼ × 5½, pp. 98. *Plan. Presented by the Trustees of the British Museum.*

South Atlantic Ocean. **Kettle.**

A Supplement to the Ninth Edition of Findlay's Sailing Directory for the South Atlantic Ocean, including revised descriptions of the East Coast of South America and the West Coast of Africa. By W. R. Kettle. London: R. H. Laurie, 1899 [1898]. Size 10 × 6¼, pp. 192. *Price* 4*s*. *Presented by the Publisher.*

Carefully brought up to date.

Tropical Diseases. **Koch.**

Reise-Berichte über Rinderpest, Bubonenpest, in Indien und Afrika, Tsetse- oder Surrakrankheit, Texasfieber, tropische Malaria, Schwarzwasserfieber. Von Robert Koch. Berlin: J. Springer, 1898. Size 9½ × 6¼, pp. 136. *Diagrams. Price* 2*s*. 6*d*.

Prof. Koch describes, in a series of official reports, the results of his observations on the cattle-disease of Africa at Kimberley, and his preventive inoculation of the plague at Bombay, and of various tropical diseases in German East Africa.

Voyage round the World. **Bullen.**

The Cruise of the *Cachalot* round the World after Sperm Whales. By Frank T. Bullen. London: Elder & Co., 1898. Size 8½ × 6, pp. xx. and 380. *Map and Illustrations. Price* 8*s*. 6*d*. *Presented by the Publishers.*

A vividly written narrative of the voyage of an American whaler round the world in search of sperm whales, ranging over all seas from the North Atlantic to the Sea of Okhotsk and the Southern Ocean.

NEW MAPS.

By J. COLES, *Map Curator*, R.G.S.

POLAR REGIONS.

Polar Regions. **Haardt.**

Nord-Polar Karte. Ausgeführt von V. v. Haardt. Scale 1 : 5,000,000 or 78·9 stat. miles to an inch. Wien : Ed. Hölzel.

This is a wall-map of the north polar regions, showing tracks of expeditions, directions of currents, and limits of the ice at different dates. Ocean depths and elevations are indicated by different shades of colouring. Insets illustrating meteorological and magnetic conditions are given; the northern boundary of permanent human habitation and the limits of vegetation are also shown.

EUROPE.

Educational.

Sammel-Atlas. Photocol. Alb.: 1, Schweiz; 2, Würtemberg; 3A, Baden; 3B, Reichslande; 4, Grossh. u. Prov. Hessen; 6, Westfalen; 7A, Prov. Sachsen; 7B, Thüringen; 8, Sachsen; 9, Provinz Brandenburg. Kunst- und Verlagsanstalt Photocol, München. *Presented by the Publishers.*

This is a series of school maps intended, by the aid of pictures, which are marked with the same numbers as places on the map, to teach children by an interesting method, the localities of important places connected with the history and industries of the several countries. Full explanations are given, in German, of this method of teaching.

England and Wales. **Ordnance Survey.**

Publications issued since January 8, 1899.

1-inch—General Maps:—

ENGLAND AND WALES:—234, 250, 265, 278, 281, 296, 327, 351 (revision), hills engraved in black or brown; 59, 68, 117, 130, 133, 170, 172, 179, 186, 197, 199, 234, 280 (revision), engraved in outline. 1*s. each.*

6-inch—County Maps:—

ENGLAND AND WALES (revision):—**Derbyshire,** 3 S.E., 7 N.E. **Durham,** 2 S.W., 3 S.W., 5 S.E., 22 N.W., S.W., 23 N.W., 30 N.W., 38 N.E., 40 N.E., 42 N.W., N.E., 46 N.W., 47 N.W., S.E., 49 S.W., 50 N.E., 53 N.E., 54 N.E., S.E., 53 N.W., N.E., S.W., S.E., 56 S.W., 57 S.E., 58 N.W. **Essex,** 3 N.E., 5 N.W., 12 N.E., 13 S.W., 30 N.E., 64A N.W., S.W. **Hampshire,** 78 S.E., 79 S.W., 83 N.E., S.E., S.W., 86 S.E., 88 N.E., 95 N.W., 98 S.E. **Hertfordshire,** 40 S.W. **Kent,** 1A S.E., 2 N.E., 4 N.W., N.E., 5 N.W., N.E., S.W., 7 S.W., 9 N.W., 13 S.W., 15 S.E., 22 N.E., 24 N.W., N.E., S.W., S.E., 25 N.W., S.W., 26 N.W., S.W., 27 S.E., 33 N.W., 34 S.W., 35 N.E., 36 N.W., S.W., 37 N.W., S.W., S.E., 38 N.W., 47 N.W., S.W., S.E., 48 N.W., S.W., 49 N.W., 55 N.E., S.W., 56 N.W., 57 N.W., S.W., 58 S.W., 65 N.W., S.E., 66 N.E., S.W., 67 N.W., N.E., S.W., S.E., 68 S.E. **Middlesex,** 1 S.W. **Northumberland,** 52 N.W., S.W., S.E., 74 N.E., 82 S.W., 100 N.W., 105 N.W., 106 S.E., 107 N.E., S.E., 110 N.E. **Sussex,** 14 S.E. **Surrey,** 7 N.W., 14 N.W., 37 N.W., S.W., 41 S.W., 44 N.W., N.E., 46 S.W. 1*s. each.*

25-inch—Parish Maps:—

ENGLAND AND WALES (revision):—**Bucks.,** VII. 15, 16; VIII. 8, 12, 13, 15; XVI. 1, 5, 9, 13, 14, 15; XVII. 14; XXII. 2, 3, 5, 9; XXIII. 13, 14; XXIX. 16; XXX. 5. **Buckinghamshire,** XXXII. 8, 9, 11, 13, 14, 15, 16; XXXIII. 6, 7, 9, 10, 11; XXXVI. 4; XXXVII. 7, 9, 13, 16; XLI. 1, 5; XLIII. 15; XLVII. 13, 14, 15; XLVIII. 3, 4, 7, 8, 11, 12, 13, 14, 15, 16; LI. 1, 2, 3, 4, 8, 9, 11, 12, 13. **Cheshire,** VI. 15; X. 15; XII. 6, 10, 15, 16; XVI. 11, 14; XXI. 8; XXII. 1, 3, 7, 9, 10, 11, 12, 13, 15; XXIII. 5, 10, 14, 15; XXX. 2, 4, 6, 7, 8, 10, 12, 16; XXXI. 2, 3, 5, 9, 12; XXXII. 2; XLVI. 6; LII. 1; LIII. 15, 16; LIX. 4, 12, 16; LXIVA. 4. **Cumberland,** LXXXII. 15, 16; LXXXIII. 8, 10, 11, 13, 15, 16; LXXXV. 3, 4, 8, 10, 11, 12, 15, 16; LXXXVI. 2, 6, 7, 10, 11, 13; LXXXVII. 3, 4, 8, 11 and 16; LXXXVIII. 3, 6, 7, 15; LXXXIX. 4 and 8; XC. 6. **Derby,** VIII. 7, 15; XXV. 6; XXVII. 4, 8, 12; XXVIII. 7, 9, 10, 11, 12; XXIX. 5, 8; XXX. 2, 5, 6, 8, 10; XXXI. 5, 6, 7, 8, 9, 10. **Flint,** XXII. 15; XXIII. 14; XXVI. 1, 2, 5. **Glamorganshire,** III. 5, 9, 15, 16; VII. 10, 16; IX. 2, 4, 5, 6, 7, 8, 10; XIV. 14; XXIII. 2, 3, 7, 15; XXXII. 4, 6, 7, 8. **Kent,** LIX. 9, 10, 11; LXVIII. 12, 16; LXIX. 1, 15. **Nottinghamshire,** V. 8, 12, 16; VIII. 4, 8, 12, 16;

XIII. 4, 8, 12, 16; XVIII. 7, 12; XXII. 6, 7, 8, 9, 10; XXIII. 2, 4, 5, 7, 8, 10, 14, 15. **Oxfordshire.** XXXV. 13, 14, 15, 16; XL. 7, 10; XLI. 3, 4, 12; XLII. 9, 13; XLVIII. 1, 5; XLIX. 1, 15; LII. 2, 3; LIII. 1, 13; LIV. 13, 14; LVI. 16; LVII. 5. **Staffordshire,** V. 12. **Sussex,** V. 3, 4, 12, 13, 14, 15, 16; VI. 1, 5, 6, 9, 10, 12, 13, 14, 15, 16; VII. 9, 11, 14; XVI. 1, 3, 4, 6, 7, 8, 11, 12, 15, 16; XVII. 1, 2, 5, 6, 7, 8, 9, 12, 13, 15, 16; XXVIII. 2, 5, 8; XXIX. 4, 9, 10, 11, 13; XLIII. 13, 14, 15, 16; XLIV. 9, 13; XLV. 13, 15, 16; XLVI. 14, 15. **Westmorland,** IX. 14; XVI. 9. *3s. each.*

(*E. Stanford, Agent.*)

Sweden. **Swedish General Staff.**

Generalstabens Karta öfver Sverige. Scale 1 : 100,000 or 1·6 stat. mile to an inch. Sheet 90, Hedemora.—Karta öfver Norbottens Lan. Scale 1 : 200,000 or 3·2 stat. miles to an inch. Sheet 41, Stensele. Generalstabens topografiska afdelning. Stockholm. *Presented by the Topographical Section of the Swedish General Staff.*

West London. **Bartholomew.**

New plan of West London. Scale 3·25 inches to a stat. mile. J. Bartholomew, F.R.G.S. W. H. Smith & Son, London, 1899. *Price* 2*s.* *Presented by J. Bartholomew & Co.*

ASIA.

China. **Friquegnon.**

Chine Meridionale et Tonkin, par le Capitaine Friquegnon de l'Infanterie de Marine. Scale 1 : 2,000,000 or 31·5 stat. miles to an inch. Service Géographique des Colonies, Paris, 1899. *Price* 7*s.*

A list of the documents consulted in the compilation of this map is given, from which it appears that the results obtained by all the best-known explorers have been used. The map includes the Yangtse valley on the north, Tongking on the south, Burma on the west, and the western part of the province of Fokien on the east. By reference to the description of the conventional signs given at the foot of the map, information may be gathered on subjects which at the present time are attracting considerable attention.

AFRICA.

Rhodesia. **Stanford.**

Map of Rhodesia divided into Provinces and Districts, under the Administration of the British South Africa Co., 1899. Scale 1 : 1,000,000 or 15·8 stat. miles to an inch. London: E. Stanford. 6 sheets. *Price* £1 4*s.*

This is a new edition, on which several corrections and additions have been made to bring it up to date.

AUSTRALASIA.

Brisbane. **Surveyor-General of Queensland.**

Brisbane and Suburbs. Street and Road Map, with Boundaries of Local Authorities. Surveyor-General's Office, Brisbane, 1897. *Presented by the Surveyor-General of Queensland.*

British New Guinea. **Macgregor.**

Map of the Eastern part of British New Guinea. From the most recent Astronomical Observations, Surveys, and Explorations, by His Excellency Sir William Macgregor, M.D., K.C.M.G., C.B., and Officers of the British New Guinea Government. 1898. Scale 1 : 380,160 or 6 stat. miles to an inch. Survey Department, Brisbane. *Presented by the Surveyor-General of Queensland.*

In consequence of the large amount of new survey work performed by Sir William Macgregor, and numerous astronomical observations taken by him, it was found necessary by the Surveyor-General of Queensland to publish the present map on a larger scale than the one previously issued by his department. This map contains a large amount of additional detail, and adds very considerably to our knowledge of the geography of British New Guinea.

ATLANTIC ISLANDS.

Canary Islands. **Rodriguez.**

Maps of the Canary Islands. By D. Manuel Pérez y Rodriguez. 1, Palma, Hierro, and Gomera. Scale 1 : 164,736. 1898.—2, Lanzarote and Fuerteventura. Scale 1 : 202,752. 1898.—3, Tenerife. Scale 1 : 164,736. 1897.—4, Gran Canaria. Scale 1 : 145,728. 1896. Madrid: Hernando y Compañia.

On these maps all roads and tracks are laid down, the altitudes of several of the principal peaks are given in metres, and the importance of towns and villages is indicated by the symbols employed to mark their position.

GENERAL.

Exploration. **Schrader.**

L'Année Cartographique. Supplément Annuel à toutes les Publications de Géographie et de Cartographie. Dressé et rédigé sous la direction de F. Schrader, directeur des travaux cartographiques de la librairie Hachette et Cie. Huitième Supplément, contenant les Modifications Géographiques et Politiques de l'Année, 1897. **Paris**: Librairie Hachette et Cie., 1898. *Price* 3 *fr.*

The first sheet of this useful atlas contains maps showing the routes followed by Mr. P. Bons d'Anty, French Consul, in Southern Yunnan, in 1896–1897. Manchuria, based on the map published by the Russian Minister of Finance, on which the railways in operation, as well as those proposed, are laid down, and two small maps showing Dr. Sven Hedin's routes in Central Asia during the years 1894–1897, as well as his exploration in the Lob Nor region, 1894–1896. The second sheet contains maps of the countries included in the bend of the Niger, compiled from the most recent material; Abyssinia and the surrounding countries; the basin of the lower Kassai; Southern Abyssinia, showing recent explorations; the country in the vicinity of the bend of the Ubangi; routes followed by Mr. J. Eyssèric on the Ivory Coast; and a map showing French explorations in the Sahara in 1897. The third sheet contains maps showing the Chilo-Argentine boundary, at present in dispute; of Southern Patagonia and Tierra del Fuego, based on the explorations of Mr. O. Nordenskiöld; Central Alaska and the Klondike region; and the North-West province of Quebec, showing the surveys of Dr. Robert Bell. Each sheet is accompanied by explanatory letterpress.

World. **Andree.**

Andrees allgemeiner Handatlas, 126 Haupt- und 139 Nebenkarten auf 186 Kartenseiten, nebst alphabetischem Namenverzeichnis. Vierte, völlig neubearbeitete, stark vermehrte Auflage, herausgegeben von A. Scobel.—Lief 47, Südostfrankreich.—Lief 48, Südamerika, Südliche Hälfte.—Lief 49, Zentralasien und Vorderindien.—Lief 50, Nördwestliches Afrika.—Lief 51, Völker, Religionen und Volksdichte der Erde. Grösse des Handels im Verhältnis zur Volkszahl.—Lief 52, Westliche und Östliche Halbkugel.—Lief 53, Sudamerika.—Lief 54, Europa, Völkerverteilung und Religionsgebiete: Mitteleuropa, Völker, Sprachen und Konfessionsgebiete.—Lief 55, Mittelamerika und Westindien.—Lief 56, Australien: Polynesische Inselgruppen: Karte der Südpolargebiete. Bielefeld und Leipzig: Verlag von Velhagen and Klasing, 1898. *Price* 50 *pf. each part.*

This new edition of Andree's Allgemeiner Handatlas is now complete, and care has been taken to bring the maps up to date.

World. **Webersik.**

Weltpost-Statistik. Telegraphen- und Telephonverkehr, Postsparkassenwesen. Von Gottlieb Webersik, k. k. Postbeamter. Wien und Leipzig: G. Freytag and Berndt. *Presented by the Author. Price* 2 *marks.*

In this little volume, statistics, graphically illustrated by diagrams, convey some very interesting information with regard to the postal and telegraphic communications of the different countries of the world.

By comparing these diagrams for different periods, one is able, by inference, to gauge the commercial progress of any country from the increase of its postal communication.

CHARTS.

Admiralty Charts. **Hydrographic Department, Admiralty.**

Charts and Plans published by the Hydrographic Department, Admiralty, November and December, 1898. *Presented by the Hydrographic Department, Admiralty.*

No.	Inches.	
2386	m = 0·45	Scotland, north coast:—Cape Wrath to the Flannan islands, including the northern parts of the North Minch and Lewis. 3*s.* 6*d.*
1996	m = 4·9	Plans on the eastern shore of the Adriatic:—Fiume, including port Martinscica. 1*s.* 6*d.*

1546 m = 0·7 Asia Minor :—Samos strait to Mandelyah gulf. 2*s.* 6*d.*
1536 m = 0·9 Lake Erie :—Long point bay. 2*s.* 6*d.*
3013 m = 4·9 Chile :—Chañaral de las Animas bay. 1*s.* 6*d.*
3008 m = {1·85 / 3·7} Anchorages in south-east Alaska :—Bartlett bay, Fritz cove, William Henry bay, Barlow cove anchorage, Swanson harbour, Funter bay. 1*s.* 6*d.*
1675 m = 0·93 Africa, west coast :—River Ponga. 1*s.* 6*d.*
625 m = 0·5 Africa, west coast :—River Congo. 1*s.* 6*d.*
638 m = 1·0 Africa, west coast :—River Congo and adjacent creeks. 2*s.* 6*d.*
3010 m = 2·0 Cochin China :—Fuyen and Ku Mong harbours. 1*s.* 6*d.*
1231 m = var. Plans on the western shore of Bering sea :—Seniavine strait, Lozhnuikh Vyestei bay, Karaga harbour, Karaginski island, Baron Korfa gulf, Natalie bay, Anastasia bay, St. Lawrence bay, Uzolnoi bay, Providence bay. 2*s.* 6*d.*
1472 m = {1·85 / 12·0} Australia, south-west coast :—Hamelin bay, Hamelin inner harbour. 1*s.* 6*d.*
2922 m = 0·5 Australia, east coast :—Turtle group to Claremont point. 3*s.*
1485 m = {0·7 / 5·9} Caroline islands :—Uap or Yap island, port Tomil. 1*s.* 6*d.*
1384 m = var. Anchorages in Loyalty islands :—Uvea bay, Iatio and Shepenehe anchorages, Tandine anchorage. 1*s.* 6*d.*
1283 Peru, Cape Lobos to Pescadores point :—Plan added, Ocoña anchorage.
2465 Anchorages in Serwatti and Tenimber islands :—Plan added, Lawawang road.
2468 Anchorages in Sumba, Timor, etc. :—Plan added, Naikliu road.
875 Ports and anchorages in China sea :—Plan added, Nau Chau passage.
1040 Kamchatka, Avatcha bay :—New plan, Petropaulovsk harbour.
731 Gilbert islands :—New plan, Nonuti.
Plan added, Apamama.
732 Gilbert islands :—New plan, Makin or Taritari.
17 Santa Cruz islands :—Plan added, Mohawk bay.
(*J. D. Potter, Agent.*)

Charts Cancelled.

No.		Cancelled by	No.
2929	Atlantic ocean, showing currents.		
2386	The North Minch.	New chart.	
2385	Scarpa island to Barvas.	Cape Wrath to the Flannan islands	2386
524	Gibraltar New Mole.		
2711	Plans of Fiume and port Martinscica on this sheet.	New chart. Plans on the eastern shore of the Adriatic	1996
1546	Strait of Samos to Mandelyah gulf.	New chart. Samos strait to Mandelyah gulf	1546
1302	Plan of Chañeral de las Animas bay on this sheet.	New chart. Chañeral de la Animas bay	3013
1675	Mouths of the river Ponga.	New chart. River Ponga	1675
625	River Congo.	New chart. River Congo	625
638	River Congo and adjacent creeks.	New chart. River Congo and adjacent creeks	638
1342	Plan of Fuyen and Kumong harbours on this sheet.	New plan. Fuyen and Kumong harbours	3010
1037	Plan of Hamelin bay on this sheet.	New chart. Hamelin bay	1472
2922	Turtle group to Claremont point.	New chart. Turtle group to Claremont	2922
779	Uap or Yap island.	New chart.	
1485	Port Tomil.	Uap or Yap island, Port Tomil.	1485
1384	Harbours in Loyalty islands.	New chart. Anchorages in Loyalty islands	1384

Charts that have received Important Corrections.

No. 1607, England, east coast:—North Foreland to the Nore. 2308, Norway:—Brand fiord to Leka. 2334, Lapland:—Oleni Nyemetzki island to Nokuev island. 2280, White sea:—Arkhangel bay. 2964, Arctic Russia:—Head of the gulf of Ob. 2842B, Baltic sea. 689, Gibraltar harbour. 150, France, south coast:—Marseille port and roadstead. 2884, Gulf of Mexico:—Legaré anchorage. 554, South America:—Magellan strait. 1897B, British Columbia:—Victoria harbour. 704, Madagascar:—Nosi Shaba to Moramba bay. 833, Bay of Bengal:—Rangoon river and approaches. 2637, Strait of Makassar, south part. 1754, China:—Tung Yung to Wen chau bay. 1708, Australia, north coast:—Albert river. 1055, Australia, west coast:—Bedout island to Cape Cuvier. 939, New Guinea:—Cape Nelson to Hercules bay. 1096, New Zealand:—Current basin and French pass. 731, Gilbert islands. 134, Harbours and anchorages in New Hebrides. 1829, Fiji islands to Samoa islands. 1757, Fiji islands:—Nukulau island to Namuka island. 2421, Tonga or Friendly islands.

(*J. D. Potter, Agent.*)

United States Charts. **U.S. Hydrographic Office.**

Pilot Charts of the North Atlantic and North Pacific Oceans for February, 1899. Published at the Hydrographic Office, Washington, D.C. *Presented by the U.S. Hydrographic Office.*

PHOTOGRAPHS.

Columbia. **Gledhill.**

Twenty-four Photographs of the Republic of Colombia, taken by E. Gledhill, Esq., 1897. *Presented by E. Gledhill, Esq.*

As will be seen by the following list, this series of photographs includes a number of interesting subjects, both as regards the buildings, groups of natives, and scenery of Colombia.

(1) The Cathedral (Plaza San Nicolas), Barranquilla; (2) Cathedral Plazuela (San Nicolas), Barranquilla; (3) El Camillon (Parade), Barranquilla; (4) Royal Mail Offices, Barranquilla; (5) Street and hotel, San Carlos, Barranquilla; (6) Custom-house, Santa Marta; (7) General view of Santa Marta, looking south-east from the sea; (8) Santa Marta, with Atlas steamer *Alps* loading bananas; (9) Street in Santa Marta, in which is situated the British Consulate; (10) Cathedral and street in Santa Marta; (11) Market hall and Plaza de la Regeneracion, Santa Marta; (12) Goajira Indians, Rio Hacha, Dept. of Magdalena; (13) Street scene on a Sunday, Rio Hacha: waiting to be photographed; (14) Characteristic groups and street in Rio Hacha; (15) Church and Plaza, with typical Indians, etc., Rio Hacha; (16) Beach and Custom-house, Rio Hacha: (17) Street scene, Cartagena; (18) Street in Cartagena; (19) Police barracks and street view, Cartagena; (20 and 21), View along old Spanish walls of Cartagena; (22) Outer portion of old Spanish fortifications near the sea; (23) View from Murallas (walls), with fortress of San Felipe in distance; (24) Walls and Rain-water tanks, Cartagena.

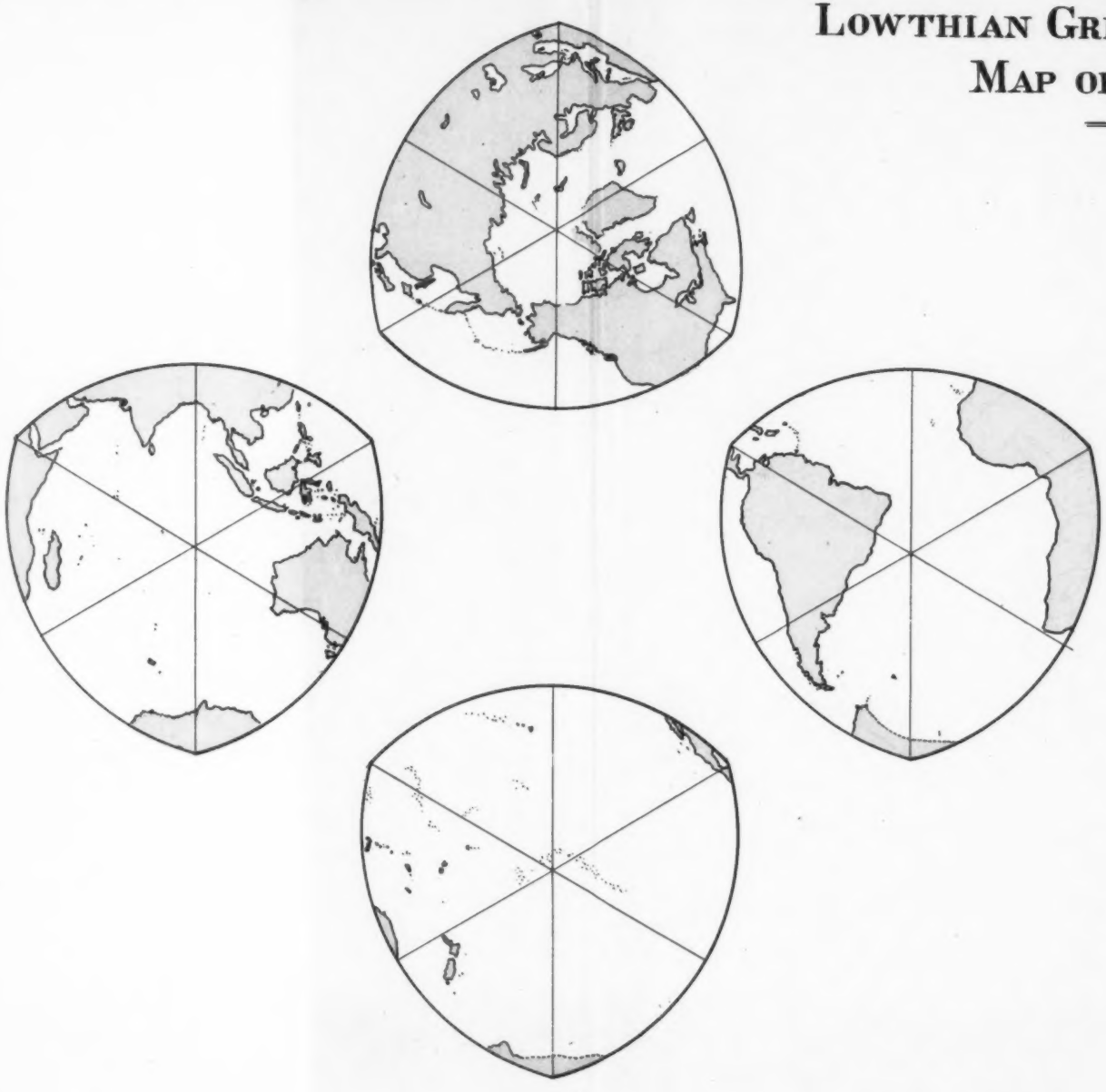
West Africa. **Yankah.**

Sixteen Photographs of Sierra Leone, Congo Railway, and Gold Coast, taken by J. T. N. Yankah, Esq. *Presented by J. B. Esuman-Gwira, Esq.*

The following is a list of these photographs: (1) Secondi market-place; (2) Fanti artisans; (3) Scene at Cape Lopez; (4) Gabun Government house; (5) Secondi railway; (6) Matadi market-place; (7) Secondi railway: laying of the first rail by Governor Hodgson; (8) Sunday school, Saltpond, Gold Coast; (9) Secondi railway station; (10) Secondi railway; (11) Secondi chief and headman; (12) Secondi; (13) Opening of the railway at Matadi; (14) Sierra Leone from the sea; (15) Secondi railway: the pier; (16) Singing band, Saltpond, Gold Coast.

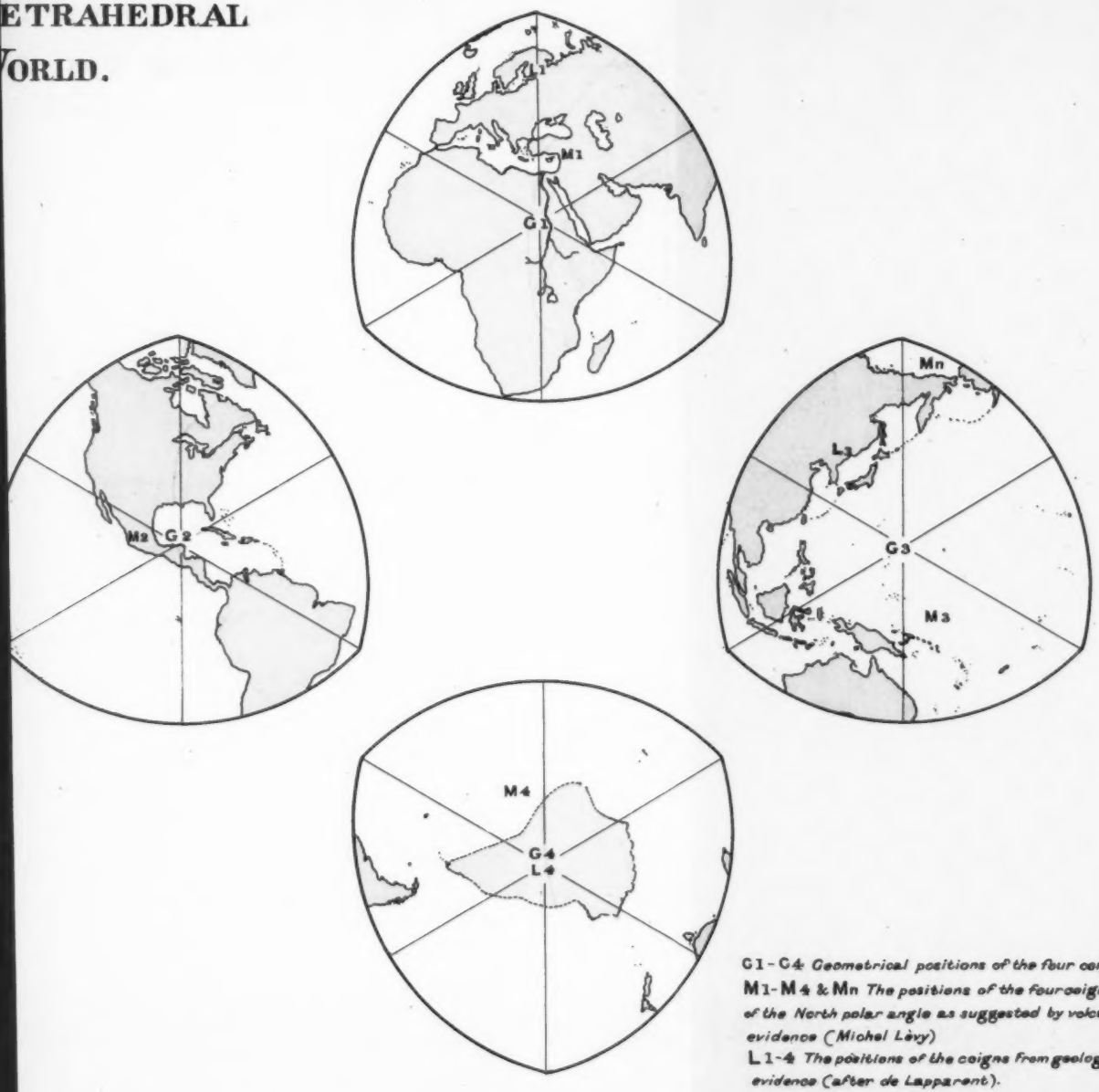
N.B.—It would greatly add to the value of the collection of Photographs which has been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.

Lowthian Green's Tetr
Map of the Worl



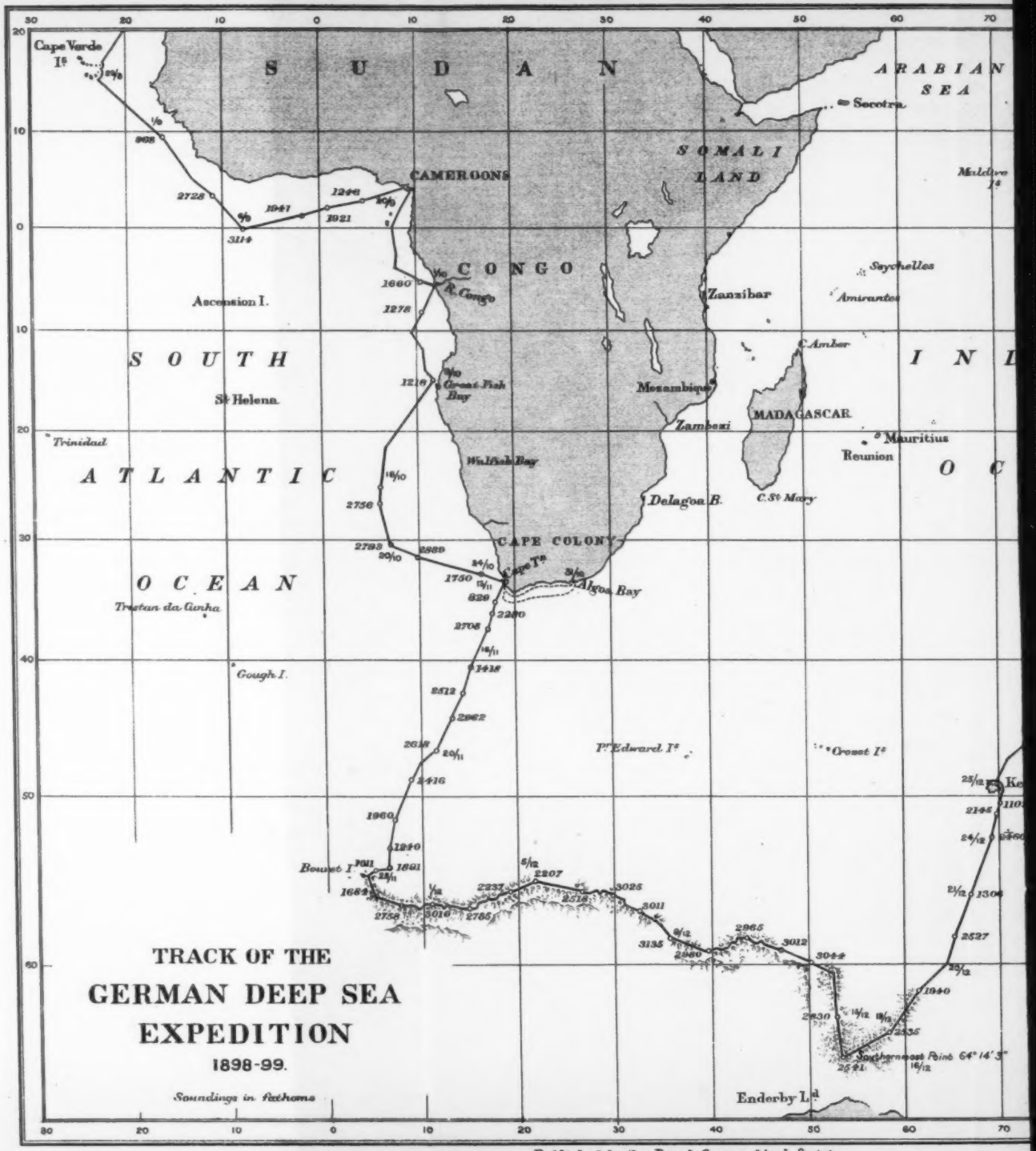
Published by the Royal Geographical Society

ETRAHEDRAL
ORLD.

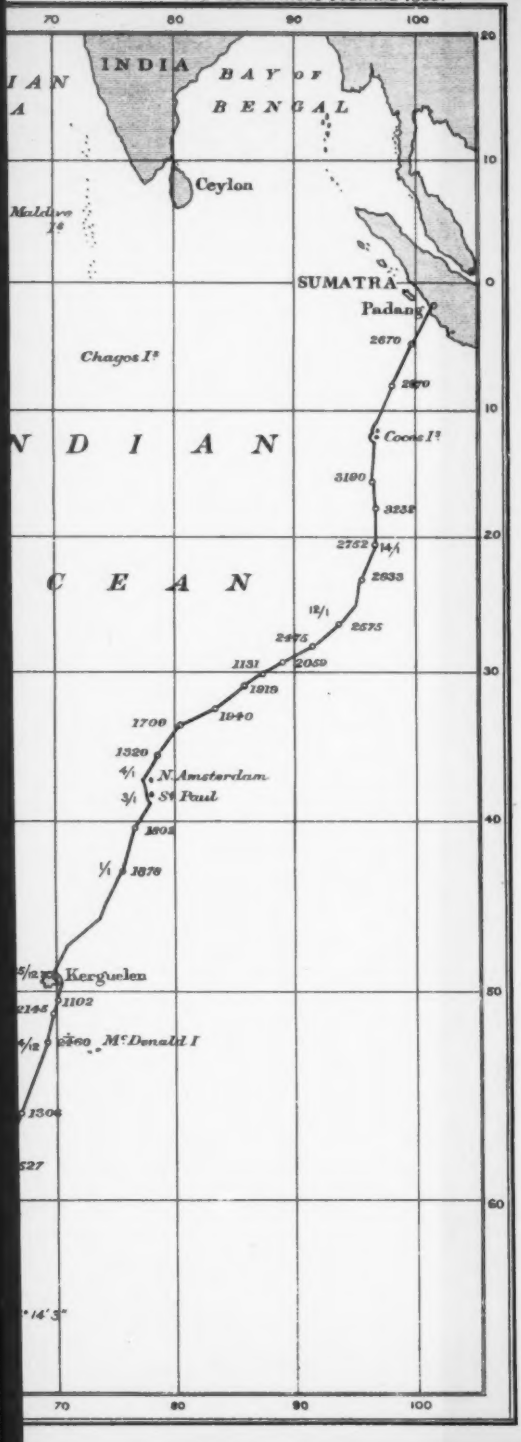


G1-G4 *Geometrical positions of the four coigns*
M1-M4 & Mn *The positions of the four coigns and of the North polar angle as suggested by volcanic evidence (Michel Lévy)*
L1-4 *The positions of the coigns from geological evidence (after de Lapparent).*

Published by the Royal Geographical Society.



Published by the Royal Geographical Society.


70
80
90
100
20
10
0
10
20
30
40
50
60
INDIA
BAY OF
BENGAL
Ceylon
Maldive Is
SUMATRA
Padang
2670
2670
Chagos Is
Cocos Is
3190
3238
2752
14/1
2633
12/1
2575
2875
2059
1131
1919
1940
1700
1520
4/1
N. Amsterdam
3/1
St Paul
1801
1/1
1670
Kerguelen
2/12
1102
2145
4/12
2460
Mc Donald I
1300
527
14° 3"